THE AMERICAN SCHOOL AND UNIVERSITY

A YEARBOOK DEVOTED TO THE DESIGN, CONSTRUCTION, EQUIPMENT, UTILIZATION, AND MAINTENANCE OF EDUCATIONAL BUILDINGS AND GROUNDS

1928-1929

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Yearbook
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Necessity Is the Mother of Publications

THE need which begot this new yearbook is in one respect an occasional and in another a constant one. To all who are responsible for enlarging and maintaining America's educational facilities comes the occasional need for new plant and equipment, and the constant need for efficiency in the use and upkeep of existing buildings and grounds.

It is to meet the demand for a compact and authoritative reference book covering both phases of this important field that THE AMERICAN SCHOOL AND UNIVERSITY has come into being. But the present volume makes its bow, not as a new-born babe among the already impressive list of educational publications, but rather as a lusty youth growing, we hope, towards a vigorous and efficient maturity. For the new yearbook is in reality an outgrowth of *The University Purchasing Guide,* which for several years has been serving an important section of the educational field, and which was purchased some months ago by the present owners, a new corporation affiliated with the publishers of *The American City Magazine* and *The Municipal Index.*

In enlarging the scope of the yearbook and in gathering the impressive series of articles which comprise the present volume, exceedingly valuable aid has been given by the Editorial Board of Advisors whose names are published on page 4. To these cooperators who have written articles or offered helpful suggestions, as well as to other authors represented in the following pages, the editors express their hearty thanks.

For the convenience of the boards of education, college trustees, superintendents and headmasters of schools, purchasing agents, architects and others who will read and consult this yearbook, its contents have been divided into the ten sections listed on the flyleaf facing the title page. Not the least important feature of the book, we are sure, will prove to be the "condensed catalogues" of materials and equipment whose grouping corresponds to that of the text pages and immediately follows the reading matter in each of the first seven sections.

Among the most notable of THE AMERICAN SCHOOL AND UNIVERSITY'S new features is the Directory of Architects, which comprises Section IX. Here are listed, for the first time, the names and addresses of 775 architects who, during the last five years, have designed three or more school or college buildings costing $50,000 or more each, the name of each architect being followed by a listing of three of his typical educational buildings.

The entire volume has been carefully indexed, both as to subjects and places (pages 8 and 9) and as to materials, equipment and names of manufacturers (pages 369 to 380). Readers are urged to call freely on the publishers for information regarding names or subjects coming within the announced scope of the yearbook and not apparently covered in the present volume. Such inquiries will be welcomed, not only as affording an opportunity for immediate service to our readers, but as offering suggestions for new features in future annual editions.

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Section I

PLANNING AND CONSTRUCTION OF EDUCATIONAL BUILDINGS

Planning School Buildings to Meet Future School Needs

BY GEORGE DRAYTON STRAYER

PROFESSOR OF EDUCATION AND DIRECTOR, INSTITUTE OF EDUCATIONAL RESEARCH, TEACHERS COLLEGE, COLUMBIA UNIVERSITY

A BUILDING program to care for the needs of the school system for a period of from ten to fifteen years is essential to the efficient development of any city school system. Too often in the past buildings have been located without reference to the need for school accommodations in the years which lie immediately ahead. In many cases buildings have had to be abandoned because the school population was moving out of a certain section of the city where the industrial and commercial area was being extended in order to take care of the growing community. In thousands of cases little buildings have been constructed on small plots of ground, ignoring the need for larger sites and larger buildings in the development of an effective school program. In one of the larger cities in which a building program was recently developed, it was discovered that in one section of the city an elementary school pupil had the choice of ten school buildings in which he might be enrolled within a radius of a half-mile. Certainly, no one would claim that there had been any planning to meet school needs in this community.

Evaluating Structures Now in Use

An essential element in a school-building program is the evaluation of the structures now in use. In all of our older communities many buildings are still used that are inadequate if judged by our modern standards of school housing. The scoring of school buildings on a score card which provides accepted standards for each of the many

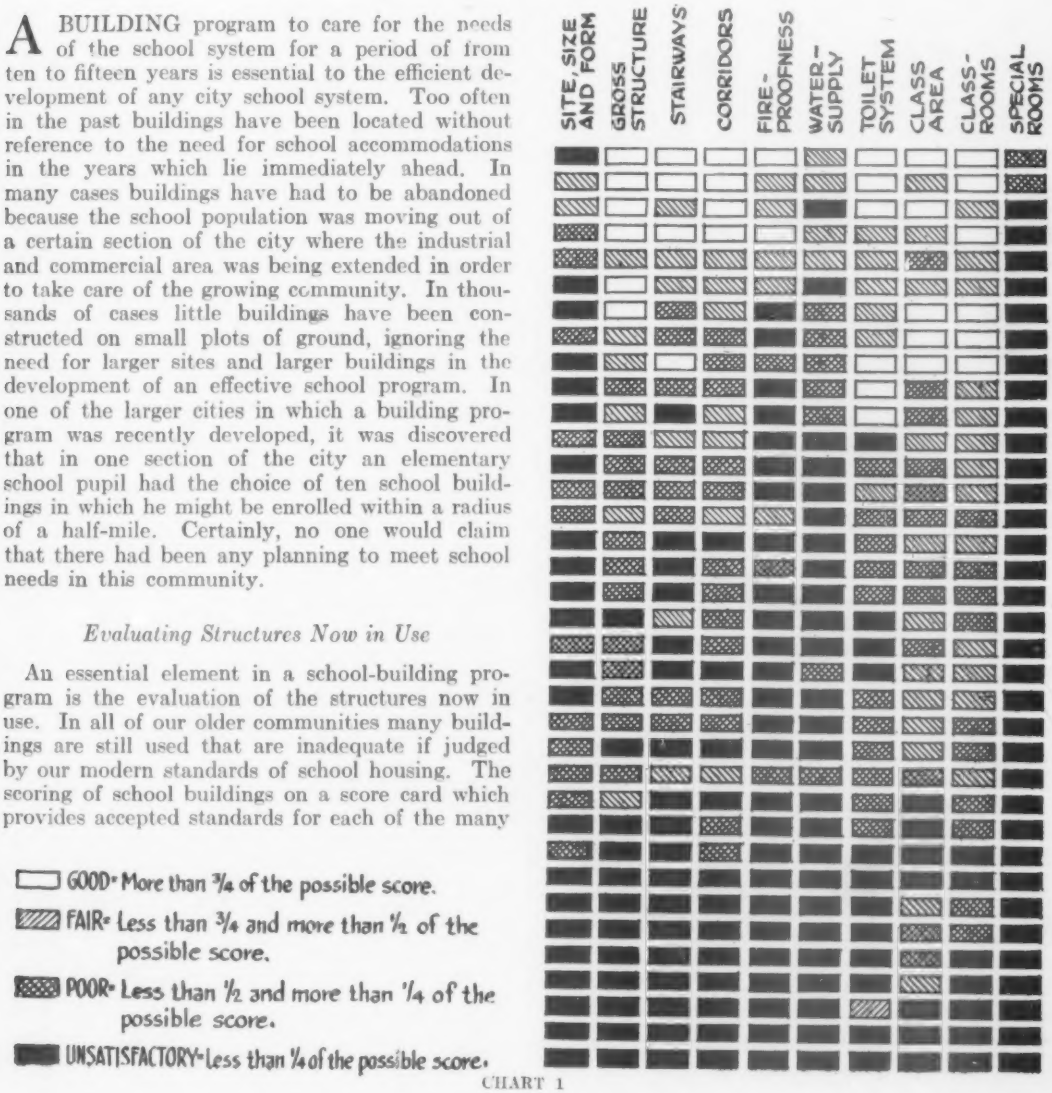

SITE, SIZE AND FORM
GROSS STRUCTURE
STAIRWAYS
CORRIDORS
FIRE-PROOFNESS
WATER-SUPPLY
TOILET SYSTEM
CLASS AREA
CLASS-ROOMS
SPECIAL ROOMS
GOOD- More than ¾ of the possible score.
FAIR- Less than ¾ and more than ½ of the possible score.
POOR- Less than ½ and more than ¼ of the possible score.
UNSATISFACTORY- Less than ¼ of the possible score.

CHART 1

factors that enter into the complete structure will reveal many deplorable situations. The results of this scoring of school buildings, represented graphically for a city of more than 100,000, appears in Chart 1. It is obvious to any one who studies this chart that at least half of the buildings in this city are so inadequate as to call for abandonment. The development of the building program will have to take account of the necessity for furnishing new accommodations for the children housed in these miserable old buildings. In the case illustrated in the graph, these inadequate structures are in every case small. This means that the number of children to be provided for, because of the number of children to be transferred to new buildings, is not great.

A rough measure of the number of children to be housed on account of increase in population is found by studying growth in total population and in school population over a period of years. It will ordinarily be found advantageous to study this growth for at least thirty years. In addition to these general growth figures, it is essential to find out how many of the children attending public schools have been enrolled in elementary schools, how many have attended junior high schools, and how many have been students in the senior high school. If there has not been a junior high school in the community, figures for this division of the school system are found by taking the enrollments in the seventh, eighth, and ninth school years. It is essential to district the city

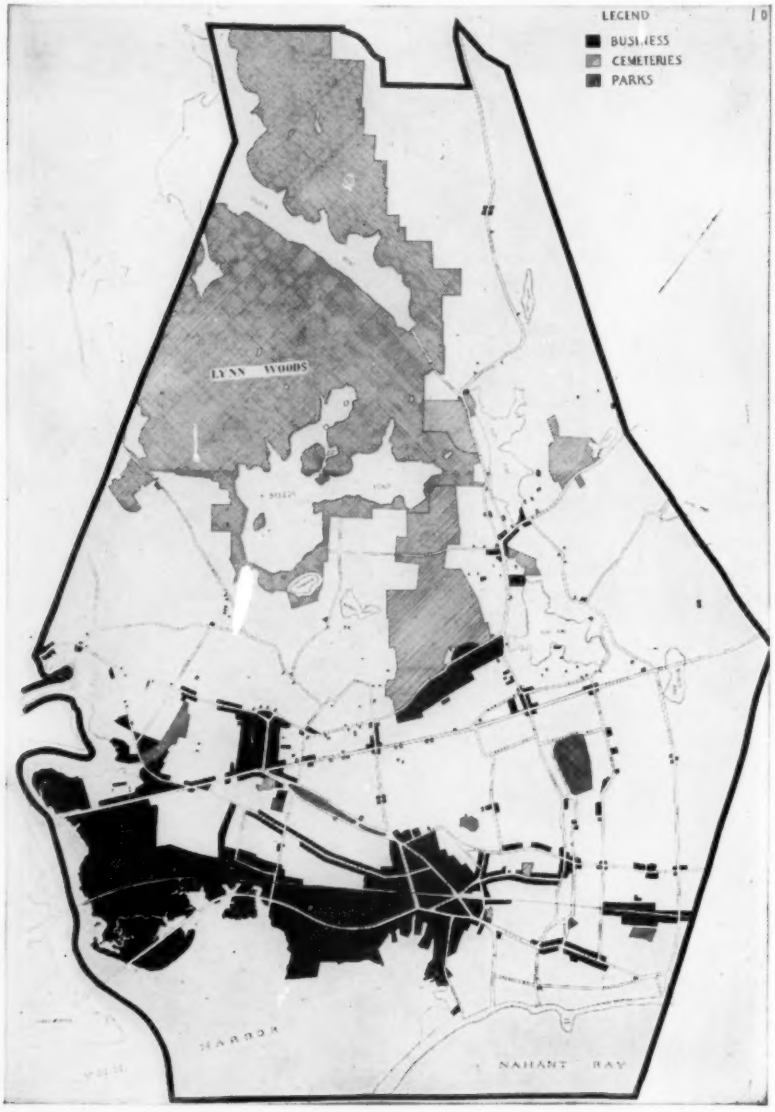


CHART 2

in order to find in which of the several areas the growth has been most constant and most rapid. The study of these districts will also reveal any tendency for the population to diminish. Studies made by the public service corporations, particularly the telephone company, are often of very great help in forecasting population within a given area.

of such a map is presented in Chart 2. It is of course essential to forecast the spread of the industrial and commercial area just as certainly as one seeks to locate the sections in which homes are being built. Where zoning ordinances have been passed, the zoning map of the city is essential in the development of the building program. An indication of the results achieved from the

CHART 3

Studying Population Trends

A school-building program must be developed in relation to the present and future homes to be served. It is necessary first of all to plot on a map all of the homes now occupied in the city. In order to get accurate data, it is often found necessary to make a block-by-block survey of the whole area covered by the municipality. In such a block survey, the character of every building is indicated. When these data are presented on a map, one gets a very good idea of the degree of residential saturation. In the study of the problem it is essential to indicate areas that are not open to future residential development, such as parks, cemeteries, and the industrial and commercial area of the city. A good illustration

study of growth in population by sections of the city is given on the map of Jacksonville, Fla., which follows.

After one has located all residences, further light may be thrown upon the situation by a study of residential permits issued over a period of years. It will ordinarily be discovered that certain sections of the city have, during the period of the past few years, been built much more rapidly than others. These facts, together with the known activities of the residential development companies, the forecast of the public service group, and the like, will aid in the forecast of population for the various sections of the city. After all of the evidence is available, one begins to make his plan with certain standards in mind. Where possible, it is desirable to provide ele-

mentary schools so as to make the maximum walking distance for children one-half mile. Except in very sparsely settled parts of the city, elementary schools should be constructed to house as many as from twelve to sixteen hundred children. The size of the building will often condition the breadth of the program that can be offered, the adequacy of the organization of the school in relation to the needs of individual children, and the possibility of providing many of the special features that are considered desirable in modern elementary school buildings.

Selecting Adequate Sites for Future Schools

In like manner, from a study of the present residential location of the junior and senior high school group, and from an estimate of the increase in the number of these children to be provided for over the period of the next fifteen years, suitable locations will be found for these school buildings. It is feasible to propose that the children of the junior high school group travel from one and a half miles to two miles to school. It is of very great importance that sites of from eight to twelve acres be secured for these buildings. For the senior high school a site of at least twenty acres is essential. The modern program of play and physical education cannot be contained within the building. In order to get the large site, it will often be found necessary to provide senior high schools in the less densely populated areas on the outer edge of the city. One of the important considerations is the availability of lines of transportation from that part of the city to be served by the particular high school. Any student of city planning will recognize the advantage in having children move out from the center of the city to the high school in the morning when the heavy traffic is in toward the center and to have these same boys and girls moving in street cars or in busses toward the center of the city in the afternoon when the heavy traffic is out from the center.

Any building program must be developed in several steps, extending over the period of years for which the forecasting is made. Accompanying the schedule of accommodations to be provided in each year, should be an estimate of the cost. The relationship of this cost to the ability of the city to finance the program, expressed in estimated tax rate, should also be included.

Many cities during the past few years have accepted the recommendations made in the report of school-building program included in city school surveys. In one case these recommendations called for an expenditure of twenty-one million dollars. Those responsible for the development of the building program were pleased to discover that the need of the city for school accommodations was made without an over-supply at the end of the period proposed for the completion of the program. Similar programs ranging in the amount of money to be expended from one million dollars in a small city to a total of more than sixty million in one of the larger cities are today being carried out. The time has come when we may definitely propose that it is just as essential to plan for future school needs in sites and buildings as it is to plan to take care of traffic in the streets, or to provide an adequate water-supply for a growing city.

The School and Its Architect

BY JOHN IRWIN BRIGHT

Ex-Chairman, Committee on School Buildings, The American Institute of Architects

Architecture as an Index to Human Progress

THE characteristics of a civilization, in very large degree, are evidenced by its buildings, for throughout the ages man has employed architecture as a tool with which to trace the record of his cultural progress. The present generation may rest assured that, in time to come, the same architectural index will be employed by our descendants in evaluating the spiritual worth of the period in which we now live. Not all the remains of antiquity are beautiful. Many of them can boast only of their ungainly bulk: When they excite our awe or admiration it is because they possess, singly or in combination, the qualities of beauty, of grandeur or of a vast and savage strength. Nevertheless, all buildings, regardless of their artistic value, are human documents casting a remorseless light on the civilization of the times and on the quality of mind of their creators.

The Rank of Church Architecture in the Middle Ages

For a thousand years after the Roman Empire had fallen, the church was the all-important public building. On it was lavished the artistic fervor of a people, for at no other period of the Christian Era has the value of religion been so exalted. And yet, notwithstanding the widespread devotion to a noble idealism, it was the virtual eclipse of secular education that caused these centuries to be branded with the invidious term, "The Dark Ages."

The Place of the School Building in Modern Life and Finance

The place that the school occupies in contemporaneous architecture is of unusual significance because, owing to its public nature, its form and appearance furnish an indication of the regard in which the people hold education.

The conviction that the school is a vital factor in everyday affairs has persisted with increasing force since the days when the monks in their monasteries kept alive the flame of learning. No longer is church construction a governmental function. The buildings that the state erects for its administrative uses are relatively few, and it has come to pass that our principal official effort in architecture is confined to scholastic buildings. For this purpose we spend of the public funds three hundred million dollars per annum, and when privately supported schools are included, the amount is almost doubled. It is by far our greatest opportunity, as a people, to foster spiritual values by means of architecture and it is a cause of deep regret when, as happens too frequently, the physical expression of such a great ideal is less than a matter of pride and glorification to all citizens. It is incongruous that a building devoted to the training of the mind and the hand in the accomplishment of the finer things of life should itself bear the stamp of illiteracy.

The School's Claim to Beauty

As physical surroundings have much to do with the state of mind of the pupil, therefore, by its effect on the eye, the building should be and can be made a practical laboratory in the training of youth. It is difficult to teach good organization effectively in poorly coordinated spaces. The lecturer on any of the graphic arts must feel a certain embarrassment when talking in a building whose surfaces bear the unmistakable stamp of ignorant vulgarity. No matter how many necessary facts a school may teach, it should not be regarded as fulfilling its true mission if it fails to instill in the minds of its pupils a sense of the fitness of things, a realization of the appropriateness of form and decoration and an ambition to approach perfection in their life work.

Inasmuch as beauty unites within itself both spiritual and practical attributes, it is difficult to overestimate its importance in the design. Beauty appeals to the eye; but it is not ornament alone. It is present in an arrangement of plan which reduces the waste of motion and leads to economy of mass. It can be further defined as the proper relationship of form and function, making for ease of administration and the conservation of time and effort and, within economic limits, as a common-sense adjustment of the building to the needs for which it is erected.

A Guide to the Selection of an Architect

The planning of the modern school is a task that calls for great technical skill and business ability fertilized with the imagination of the artist. Much of the blame for an inefficient plan and an ignoble facade must be borne by those in the place of authority who, in the selection of a designer, give insufficient weight to the quality of architectural competence. Those about to choose an architect who can successfully discharge the exacting duties of his profession should demand that he fulfill certain definite requirements:

(a) An architect should enjoy a favorable reputation among his fellows.

(b) The architect should be a man of sound professional attainments who is able to place at the disposition of his clients an acknowledged skill in design and an executive ability of a high order. It is not necessary that he should be reputed a specialist, although he should be informed of the various phases of the problem connected with the planning and the operating of educational buildings.

(c) The architect should possess that supreme but intangible quality, intelligence. Technical mastery of the subject without the saving grace of intelligence is of little worth. Bearing heavily upon school design is a weighty mass of "rules and regulations," standards buttressed by authority and custom, some of them useful, some of them unfortunate. Without doubt they tend to lessen errors of an obvious nature. The unimaginative plodder is inclined to accept these precepts too literally and welcomes them as a staff upon which to lean in rendering his commonplace service; while the man possessed of an inventive mind molds them to his own use, taking advantage of every circumstance in the worthy accomplishment of his task.

Three methods among others should be used in gathering information leading to the employment of an architect.

(a) His former clients should be questioned on topics of general information.

(b) His previous work, schools or otherwise, should be examined. An architect should not be rejected on the sole ground of his youth or the lack of impressive accomplishment. If he has sound training in the fundamentals of his art, the very handicap of the comparative lack of experience may lead him to contribute to the work a fresh point of view and an enthusiasm that do not always accompany established reputations.

(c) Disinterested architects should be consulted. The advice of the architectural organization of which he may happen to be a member should be obtained.

Once the choice has been made, the architect should be given a remuneration in accord with his merits; a fair compensation, one that will permit him to work without financial embarrassments. It is a policy that will return dividends to the employers and to the community. Good advice is worth more than poor advice. Architectural skill is not a commodity to be bought in the open market. No two architects will produce the same result. The skillful designer will know how to obtain his ends with the least possible cubage and money, and by so doing he will effect direct and indirect savings which a less able man could never accomplish.

There is another line of approach that must not be neglected when seeking professional advice. In the search for merit one must be able to recognize and reject the undesirable.

Certain things cannot be ignored without danger. It is always a bad sign when the ethics of the profession are treated with indifference. A word of warning must be uttered against the practitioner who, however plausibly, offers free services or advice as a lure for his retention. Any proposal of this kind should be narrowly examined, for the reason that estimates, drawings and promises, given under these conditions, are apt to have small basis in fact once the real work of construction is started. While it is impossible to lay down a rule to cover each particular case, the American Institute of Architects, in common with most other professional bodies, is strongly opposed in principle to such practices, judging them to be harmful to both the public and the private interest. On the other hand, when a committee invites a man to appear before it in the hope of obtaining something of value at no cost to itself, it must assume the blame if the outcome is disappointing.

Again, the architect who makes financial concessions in order to obtain his appointment, is advancing on a dangerous path both for himself and for his client. Under conditions of modern practice, in order that it may be possible to properly fulfill his duty to his client, an architect is put to a very large expense which, today, is constantly mounting. He knows the cost of his own work and should demand a just remuneration at the beginning. If after this he foregoes any serious proportion of his compensation, he will be compelled to do one of two things—diminish the quality of his services, or else make a personal contribution to the fortune of his employer. There is no third course, and the situation cannot be allowed to arise without jeopardizing the success of the undertaking and the good reputations of all concerned.

More in public schools than in private institutions, there is too much attention paid to questions such as the cost per cubic foot, pupil capacity in terms of volume and money and things countable. There are scores of books on the subject written by the inventors of formulæ and mathematical expressions that serve only to confuse the issue unless accorded their proper place in the analysis of what, after all, is an architectural problem. Facts are always invaluable but, alas, they are seldom plain. They need skillful interpretation to be understood. Interest in these statistics would be justified if they led to a better and more economical handling of mass and material. But such is not always the case. Much of this talk is only employed to mask ignorance and insufficient training, leaving the larger questions untouched.

Those whose duty it is to select an architect for a school or college should realize that the project symbolizes the aspirations of a people and is worthy of any honor that can be paid to it. As the seat of culture and learning, it can claim as its right the services of the most gifted and the place of honor as the preëminent structure in the community.

James Gamble Rogers—Childs & Smith, Associated Architects

ARCHITECT'S SKETCH OF THE CHICAGO GROUP, NORTHWESTERN UNIVERSITY, AS SEEN FROM THE EAST

Skyscraper Design Essential to University's Social Service Program in Chicago

JAMES GAMBLE ROGERS

ARCHITECT, NEW YORK

TRUE to the spirit of Chicago, where affairs move forward with majestic strides to great and distinctive ends, the Northwestern University Group on McKinlock Memorial Campus has grown up in a manner and with the effect of no other educational center now in existence. Universities usually start with one or two small buildings and expand gradually by the addition of such uniformly low structures as have come to be considered typical university architecture. They are most often in small towns or cities, or suburban sections of large ones. The Chicago Group of Northwestern University, however, three years ago only a colossal dream of a skyscraper educational center in a skyscraper city is today, through splendid organization and cooperation on the part of many interests concerned, a colossal dream come true.

The beautiful Gothic architecture of the Harkness Memorial Tower at Yale University furnished the inspiration for this great group of buildings. The buildings themselves, however, have been developed in a freer and more modern Gothic. The architects (the writer, and the firm of Childs & Smith of Chicago, who were associated with him in the undertaking) conceived a group mass, developed from Lake Shore Drive, rising in a series of irregularly graduated forms starting with the Gary Library of Law and the Levy Mayer Hall of Law, as shown, then higher with the Weiboldt Hall of Commerce, and still higher to the Montgomery Ward Memorial, the great central tower which dominates the entire scheme. The varied, craggy, stalagmitic forms thus developed give a diversified interest to the architecture which would be extremely picturesque in any environment and

which stands out almost startlingly in the north-central district of Chicago.

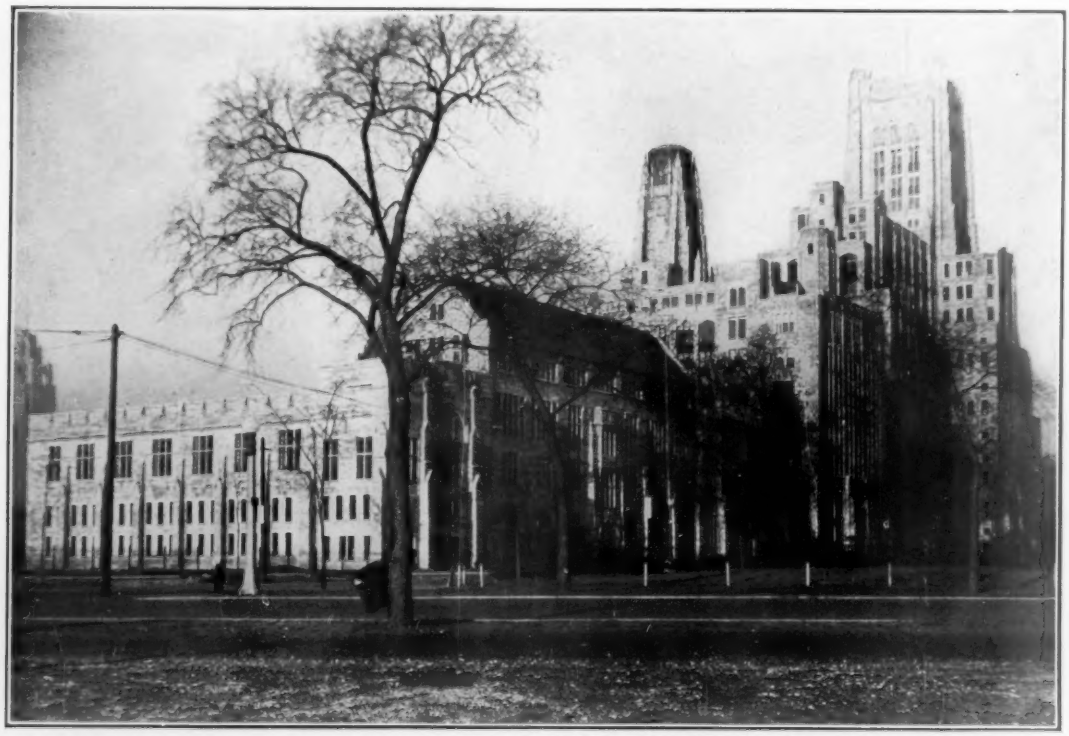
There was a utilitarian as well as an esthetic consideration involved in the planning of this great scheme. Had all the units been designed of the same height, it would have been impossible to have proper light and air in all the rooms.

The buildings, taken in the order of their rising height, are as follows:

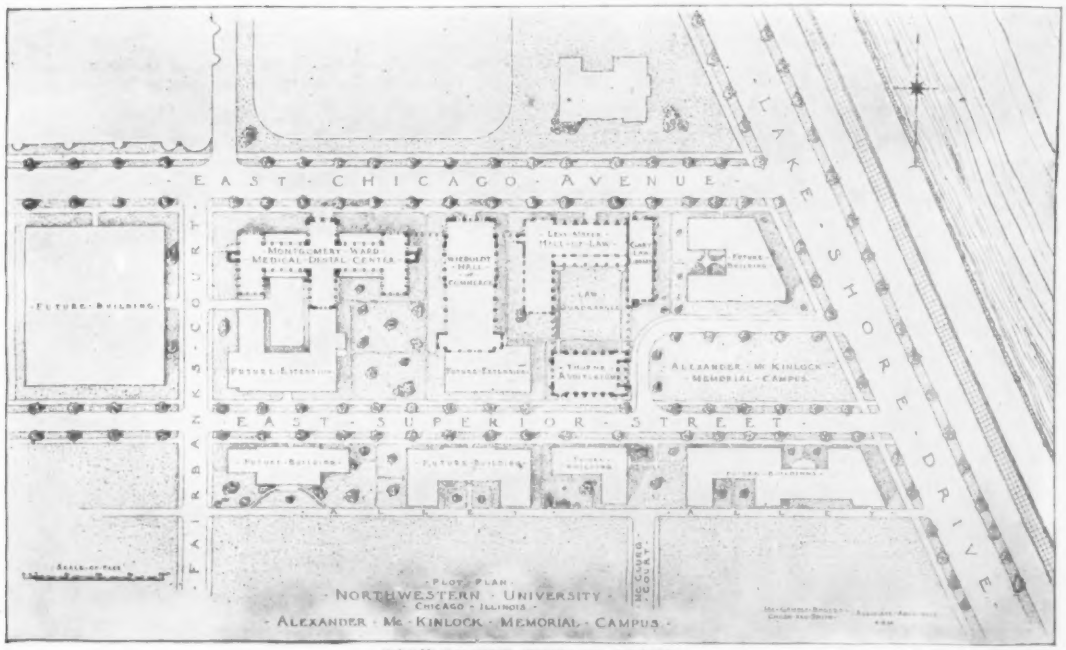
The Law Group which, though but four stories high, is the most imposing architecturally, in its general plan, in the material used for its construction, and in decorative detail, of any of the buildings. It is U-formed and occupies three sides of a quadrangle, the fourth side of which will provide a site for the future Thorne Auditorium. Its main four-story building is to the north. It houses four lecture rooms, one of which is arranged as a court room; spacious offices for the faculty; offices for a legal clinic; a law journal office; space for a research department; students' club and class rooms; and the Gary Library of Law building. One of the main features of Lincoln Hall, the large lecture room, is the arrangement of the seats, as shown in the illustration, in a manner similar to that in the House of Commons, London.

Immediately to the west of the Law Group rises the Wieboldt Hall of Commerce, which has for its outstanding feature what a Chicago newspaper man has called "the most beautiful smokestack in America." This immense funnel has an internal diameter of 11 feet, 3 inches. It is placed in the center wing of the E-shaped plan, and by the addition of stairs, elevators, and toilets, is enlarged into a tapering Gothic tower. The central heating plant, which occupies the two lower stories of the building, includes space for all the mechanical equipment of the entire University for years to come, and is connected with enormous underground coal bunkers. The School of Commerce, above the heating plant, has a capacity of 20 classrooms, with a total seating capacity of 1,500, ample office space, a research department, a library, club-rooms for men and women students, and a separate floor for the Open Court Publishing Company. The entrance is in front of the heating plant. Roof gardens adjoining the club rooms have been developed by utilization of the roofs of the entrance and the heating plant where these extend beyond the upper stories. The class rooms are arranged in a conventional E-shaped design.

The Montgomery Ward Memorial Building, dominating the group, is 14 stories high, with an additional six stories in the central Gothic tower that rises as a climax to the ascending height scheme. On its first seven floors is housed the Medical School; on the next six the Dental School; and in the tower and on a section of the first floor near the entrance is space for general university administration offices. The Medical Department is so placed as to connect directly with the main Clinic and General Hospital to be



NORTHEAST ELEVATION, NORTHWESTERN UNIVERSITY GROUP AT McKINLOCK MEMORIAL CAMPUS, CHICAGO



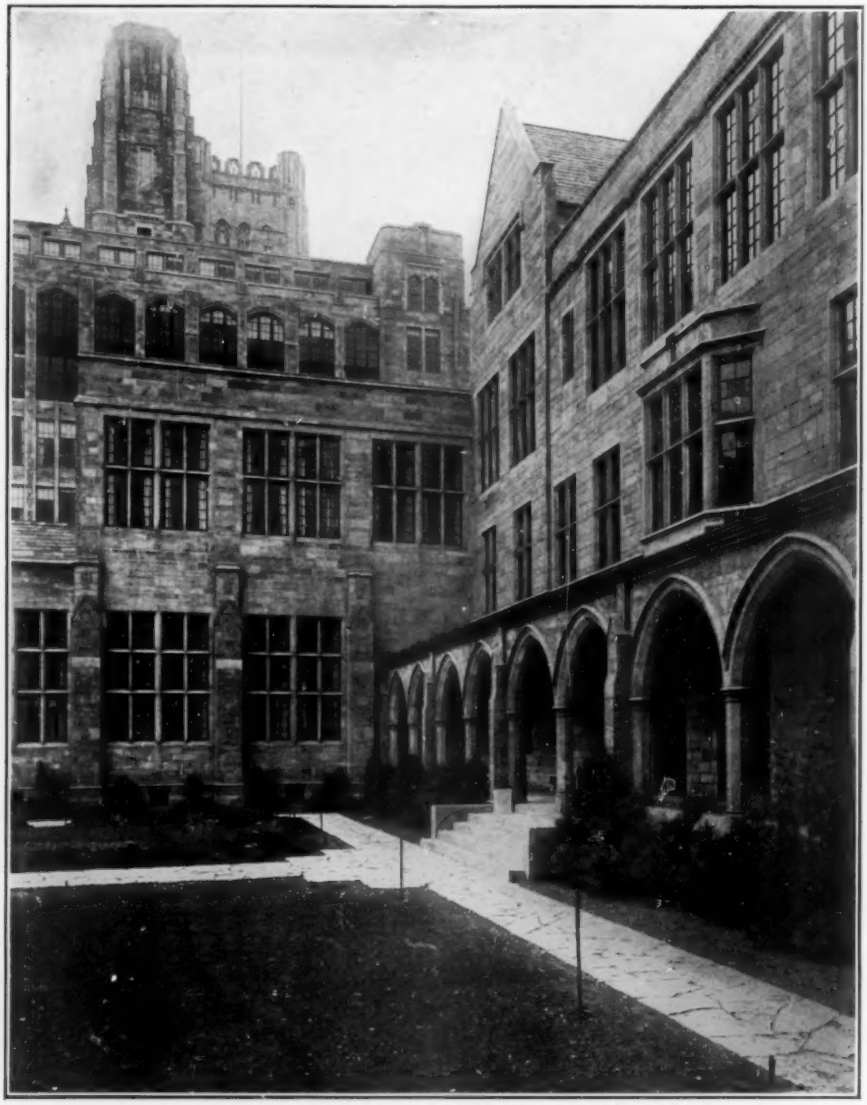
PLAN OF THE CHICAGO GROUP

built to the immediate south. It is also properly located geographically in relation to the contemplated hospital to the west, and other hospitals to the south beyond the General Clinic Building. The Dental Department has its laboratory and office space divided in a manner similar to that of the Medical Department, except that the sectional system of instruction will permit smaller classrooms, and thereby the east and west wings were permitted to be stepped back without interfering with space requirements. The Dental Clinic occupies the eleventh, twelfth, and thirteenth floors, where especially large window space is available. The fourteenth floor houses the animal

THE CHICAGO GROUP OF NORTHWESTERN UNIVERSITY, SHOWING (LEFT TO RIGHT) LAW SCHOOL, SCHOOL OF COMMERCE AND MEDICAL AND DENTAL CENTER

operating room, conducted in conjunction with the study of surgery. It is skylighted. The tower is devoted to the offices of the President and the Alumni Association, and provides meeting places for the trustees and faculties of the various schools.

All buildings are of fireproof construction, having steel columns and concrete floors.



PORTICO IN COURTYARD, LEVY MAYER HALL OF LAW

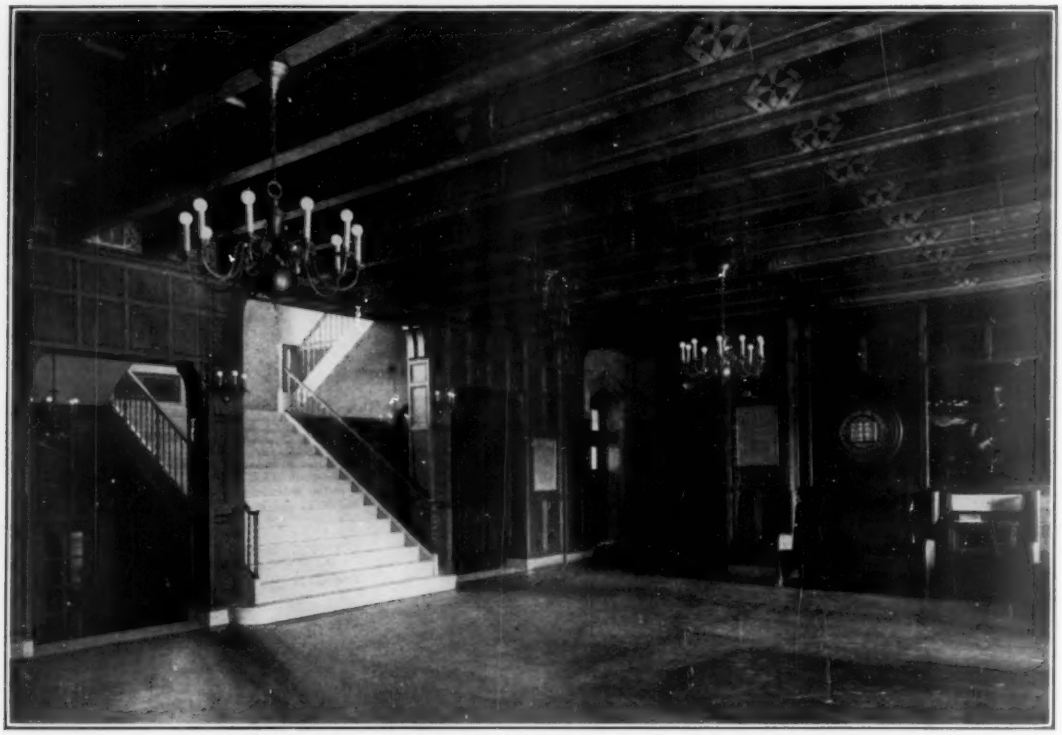
The Medical School has a student body of over 500, the Dental School has 400, and together they minister to over 200,000 clinical visitors from among Chicago's poor and indigent annually. The School of Commerce has an enrollment of nearly 5,000 men and women who are completing their education at afternoon and evening classes, and a specialized research service maintained in the public interest. The Law School has an enrollment of 300 students and maintains a free-service legal clinic where 10,000 cases per year are handled in the interest of justice to the poor. The Elbert H. Gary Library of Law serves not only the students and the legal profession of Chicago and Cook County, but is of national interest and importance as well.

In these uses is to be found the answer to the question of why these professional schools of the Northwestern University could not very well be developed on a cheap-land area outside the city. A vital part of their existence is their constant service to a large element *of the city*.

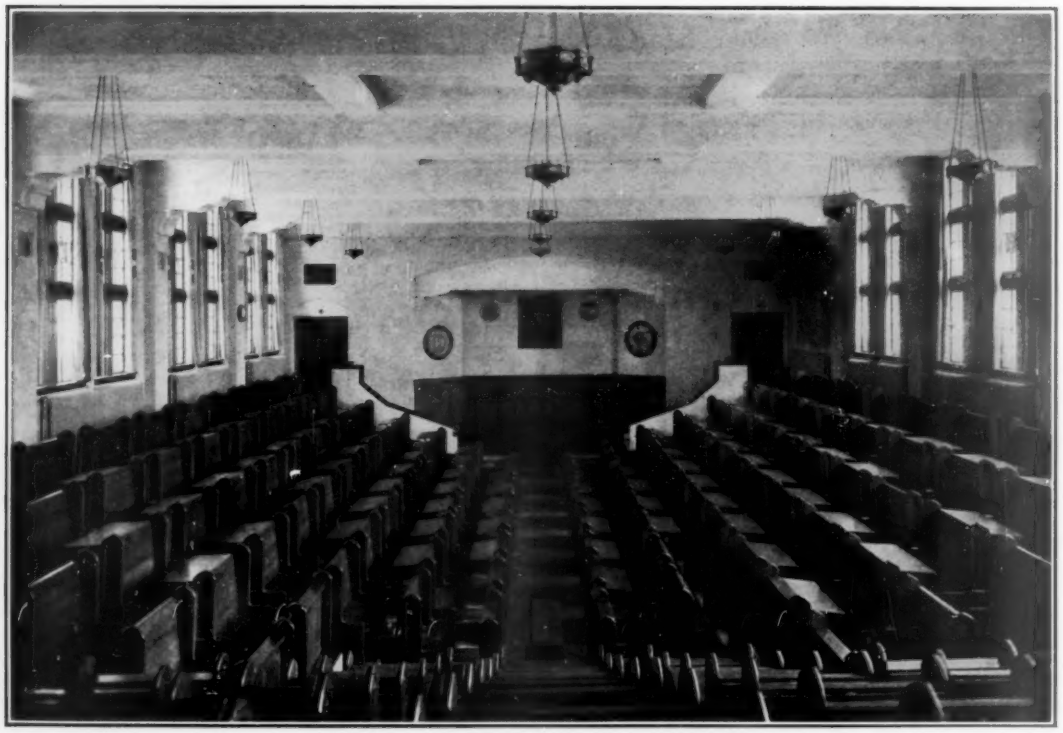
Magnificent as is the great mass now looming up, it is but the beginning of a group which is designed to take up the entire campus space and extend outside in two directions.

CORRIDOR, ELBERT H. GARY LIBRARY OF LAW, McKINLOCK MEMORIAL CAMPUS, NORTHWESTERN UNIVERSITY

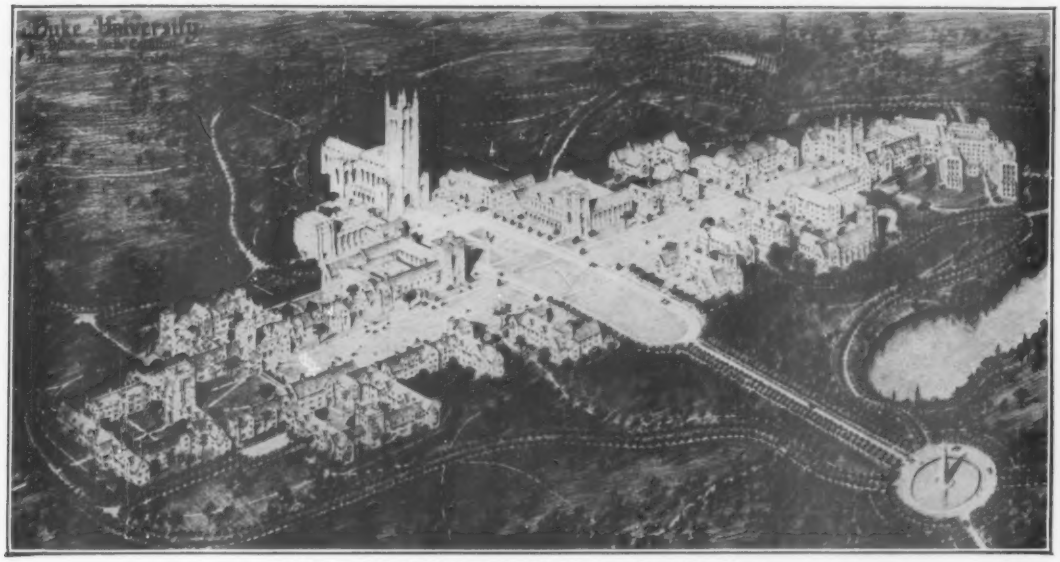
MAIN ENTRANCE CORRIDOR, MONTGOMERY WARD MEMORIAL BUILDING, McKINLOCK MEMORIAL CAMPUS, NORTHWESTERN UNIVERSITY



MAIN ENTRANCE CORRIDOR, LEVY MAYER HALL OF LAW



LINCOLN HALL, LEVY MAYER HALL OF LAW



GROUP PLAN, DUKE UNIVERSITY, DURHAM, N. C.

The Building and Organizing of Duke University

BY W. P. FEW

PRESIDENT OF THE UNIVERSITY

DUKE UNIVERSITY, at Durham, N. C., owes its existence to a great Trust set up by James B. Duke, December 11, 1924; to gifts made by him in the succeeding year; and to bequests that came to the University at his death, October 10, 1925.

The new University is being built around Trinity College, which goes back in its origins to 1838 and which will continue as the Undergraduate College for Men. The plant on the present campus with its twelve new buildings will be used by women as soon as it can be turned over to them, perhaps in 1930; and all departments of the University except the Woman's College will go to the new plant which is being built on contiguous land but is about one mile distant from the present campus.

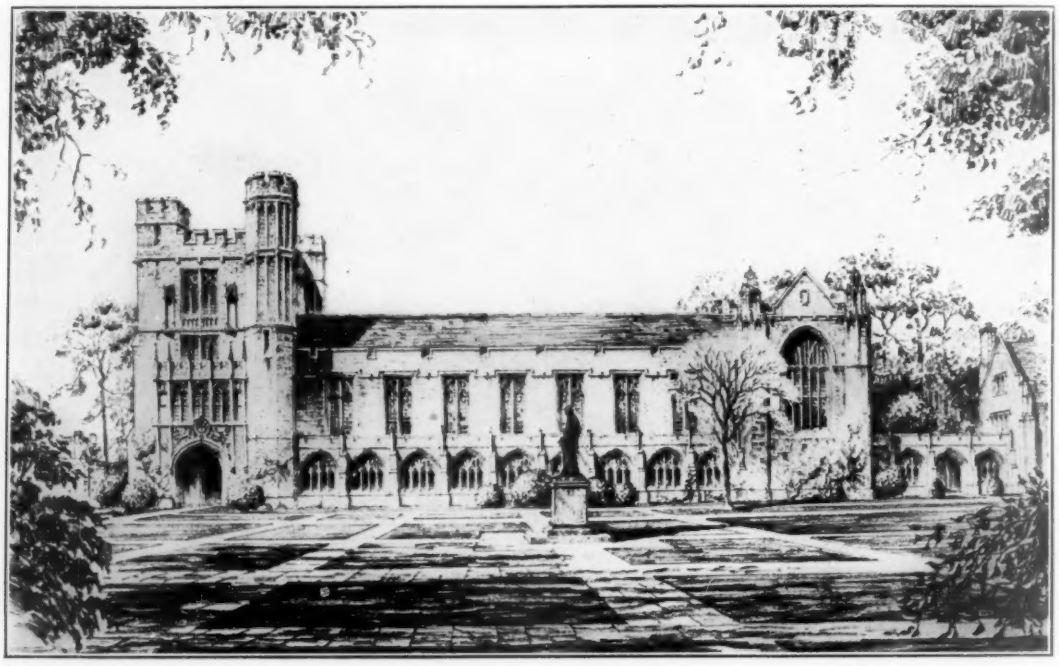
In addition to the Undergraduate College for Men and the Undergraduate College for Women, there will be a Graduate School of Arts and Sciences, and Schools of Law, Medicine, and Religion. The building for all these is now in progress. We fully realize the overwhelming financial burden that would be involved in the complete establishment at once of two undergraduate colleges and four graduate and professional schools. We mean to do well what we undertake to do. We therefore plan to develop these schools gradually and with such limitations upon offerings and numbers of students as may be necessary.

In the undergraduate colleges there will be a rather sharp demarcation between the work of the first two years and the work of the last two years. Students will be accepted for college through careful processes of selective admission and for the first two years they will be under the guidance of teachers who have been chosen for their personal qualities and teaching power as well as for knowledge of their subjects. Advanced sections will provide opportunities for the more ambitious freshmen and sophomores to go forward as rapidly as they will. Such students, after two years in college, including diligent summer reading, will have the chance to enter our professional schools or to take such advanced courses in the college or graduate school as they may be prepared to take.

We have a field for medical education that is largely uncultivated, and therefore one of our first concerns will be for a school of medicine that will meet the needs of this territory. We hope to build a first-rate medical school that will be devoted equally to science and to service. Exceptionally able men who have finished the sophomore year in college will probably be admitted to the Medical School, and the School will

MEDICAL SCHOOL OF THE UNIVERSITY

run through four quarters, so that the four-year medical course may be completed in three calendar years. It will be sympathetically related to the system of county hospitals now being developed in North and South Carolina under the stimulus of a hospitalization fund which is a part of the foundation that also created Duke University. Dr. W. C. Davison, Assistant Dean at



Horace Trumbauer, Architect

LOOKING ACROSS THE CAMPUS TO THE UNION, DUKE UNIVERSITY

COLLEGE FOR WOMEN, DUKE UNIVERSITY

Johns Hopkins, has been made Dean of Medicine, and is now engaged with the building plans and the assembling of a faculty for the Medical School, which will not be ready to receive students before September, 1930.

We have already in process of organization a Graduate School of Arts and Sciences. This will follow the same general lines that are followed in the best American graduate schools, but as our plans mature, we hope to separate more sharply between the college and the graduate school and to give to the work of the graduate school a more distinctively university character than has heretofore been the rule in this country.

And, in our efforts to meet the varying needs of those men who would fit themselves primarily for the business of teaching, and, on the other hand, the needs of those who would give their first concern to research and scholarship, we shall also hope to differentiate clearly both in the type of graduate school teacher and in the courses and methods of instruction.

While our School of Arts and Sciences will keep prominent this purpose to discover and develop men who have some special fitness for the business of teaching, still a large proportion of its men and resources will be devoted to research and the advancement of knowledge, with especial emphasis on mathematics, chemistry, physics, and biology, and working in close cooperation with the Medical School; and on the social sciences, including law.

We have in mind to make the School of Law in Duke University not just a professional training school for those who intend to practice at the bar, but a school that, along with professional preparation, will also provide liberal training in law as one of the social sciences closely allied with government, economics, and business administration. Such a school could be developed rapidly here because it would not have to fight its way against opposing traditions.

We have well on the way to complete organization a Graduate School of Religion. We shall, as a matter of course, expect this School to use the best results and the best methods of those remarkable linguistic, literary, and historical studies that have done so much for scholarship in the past fifty years, and also the best results, and, so far as they apply, the best methods in other branches of learning—in archaeology, in astronomy, in geology, and in other sciences that have brought to light new facts and that have thus made necessary new adaptations of old truths. We earnestly covet for this School eminent scholars and eminent thinkers who will have some of the power to "originate creative ideas" for the coming generation and can speak their message with some of the authority that has belonged to those authentic spiritual and intellectual founders and builders of every great age in the past.

I have sought to intimate with outlines some of the ways by which Duke University would make its appropriate contributions to the educational service of the nation, and also something of the spirit that prompts the University as it enters upon its happy mission of helping (in the words of Mr. Duke) "to develop our resources, increase our wisdom, and promote human happiness."

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Auditorium Seats—American Seating Co.
Classroom Furniture—Southern Desk Co.
Clocks and Signal Systems—International Time Recording Co.
Drinking Fountains and Plumbing Fixtures—Crane Co.
Fire Alarms—Holtzer-Cabot Electric Co.
Gymnasium Equipment—A. G. Spalding & Bros.
Heat Regulating System—Johnson Service Co.
Laboratory Equipment—Kewaunee Mfg. Co.
Library Equipment—The Library Bureau.
Lockers—Fred Medart Mfg. Co.
Office Equipment—The Macey Co.
Projecting Equipment for Moving Pictures—Bausch & Lomb Optical Co.

Research on School-Building Problems

Its Accomplishments—Its Further Field

BY N. L. ENGELHARDT

PROFESSOR OF EDUCATION, TEACHERS COLLEGE, COLUMBIA UNIVERSITY

IT is not unusual for a city school system in which the annual budget for current expense approximates $150,000 to authorize bond issues for capital outlay which vary from this sum to as much as $600,000 or $700,000. A bond issue for new school buildings, in many school systems, has been two, three or more times the amount of money involved in the annual expenditure for running a school system. In a normal year in the United States, $500,000,000 in the aggregate is spent on new educational buildings. In the larger cities in the United States, school-building programs have been projected and accepted which have necessitated the expenditure of sums ranging from $10,000,000 to $100,000,000, all of which has been spent within a period of three to five years.

It should be the purpose of the educational profession to conserve these vast expenditures of money to the end that every possible economy may be achieved, that schoolhouses may be better adapted to the service to be rendered therein, and that the greatest possible part of the educational purchasing power of communities may be devoted to the instructional program.

During the first quarter of the twentieth century, exceedingly rapid progress was made in the United States in the betterment of schoolhouses and in the acquisition of larger school sites. During this period, hundreds of superior consolidated schools were substituted for isolated one-room buildings, worn-out and wretched city schools were replaced with attractive fire-resistive structures, and school grounds of reasonable size were purchased, equipped with play apparatus and frequently landscaped with beautiful trees, shrubs and lawns. During this period of development, it was natural that many mistakes in planning would be made. It is recognized that, although the progress was significant, many thousands of dollars were spent on school buildings which, in some cases, may be considered only as a temporary and not as a permanent investment and which, in altogether too many other cases, must be considered a dead loss rather than a substantial investment for public education.

During the past two decades, standards for school systems have been prepared based upon decisions made by juries of competent judges. These standards, with their attendant score cards,[1] have been used widely in school systems by local administrators or by survey groups to point out the merits of existing school plants or to uncover defects in existing buildings. These standards have also frequently been used by architects and school administrators in the planning of new structures. It was logical that there should result from the application of these standards and score cards a program of scientific research founded on the hope that thoroughgoing studies of all aspects of school-building planning would assist in the refinement of standards, the further elimination of waste, and an approximation to a possible complete utilization of the investment.

The Existing Bibliography on School Building

The degree to which school-building problems have been matters of concern to the public in general, as well as to school administrators in particular, may be in part measured by the number of books, pamphlets and magazine articles which are available in this field. A bibliography[2] of such books and articles covering the period 1915-1925 has been prepared. Over 4,000 titles appear in this list. The significant feature of this bibliography is a small group of impartial scientific studies which have been developed in schools of education throughout the country or under the auspices of special foundations. These studies range widely from the relationship which a state education department should have to local school-building programs through the development of standards for special classrooms down to the determination of the most satisfactory and most economical equipment to be utilized in an elementary classroom.

It will be impossible in this article to attempt to refer to all of the significant studies of this kind which have been made. The number of studies made is also a very small percentage of the total number of solutions which must be secured in this field.

What Are the School-Building Problems?

A recently prepared book on school building problems[3] contains 119 major problems requiring solution, with as many as five to ten minor problems in each of the major fields. A partial significance of the importance of some of these problems may be secured from a mere statement

[1] Strayer, G. D., and Engelhardt, N. L.: "Score Card for Elementary School Buildings"; "Score Card for High School Buildings"; "Score Card for Village or Rural School Buildings of Four Teachers or Less." Bureau of Publications, Teachers College, Columbia University, New York.

Ashbaugh, E. J., and Stevenson, P. R.: "A Score Card for Rural School Buildings." Ohio State University, Columbus, Ohio.

Butterworth, J. E.: "The Butterworth School Building Score Card." World Book Co., Yonkers-on-Hudson, N. Y.

[2] Available in typewritten form at Russell Library, Teachers College, Columbia University. Prepared by N. L. Engelhardt and E. L. Morphet.

[3] Strayer, G. D., and Engelhardt, N. L.: "School Building Problems." Bureau of Publications, Teachers College, Columbia University. 1927.

of a few of the titles of the many problems requiring solution: the determination of the possible residential saturation of a community; the influence of new school buildings upon the values of adjoining real estate; the preferred plan for the organization and administration of a school-building program; the preferred method to be followed in employing architectural service; the standards to be followed in the development of specifications and working drawings for a school plant; what types of floors are most permanent and are best adapted for school purposes; the most satisfactory system of ventilation for schoolhouses; the optimum size of high schools; the size of the auditorium in relationship to the school enrollment; the character and amount of the physical education facilities; the budgeting of equipment for a new school building; the methods of financing a school-building project; and the most advantageous method and period for the sale of school bonds.

Hart,[4] in "A Standard State Schoolhousing Code," emphasizes the significance of the school-building program by pointing out that within one year, fourteen cities in the United States with a total population of 1,736,000 people had bonded themselves for $38,000,000 for school purposes, approximately $22 for each inhabitant.

Aids for Those Planning Schoolhouses

This author developed certain instruments for the purpose of forcing a recognition of the standards of schoolhousing which had already been set up. Hart emphasizes the importance of having the state coöperate with the local school authorities in recognizing the advance information which research was making available. The instruments which he suggests as aids to those planning schoolhouses are:

1. A standard form upon which school authorities can, with a minimum of effort and a maximum of certainty, render a complete, clear-cut statement of any building problem they wish to present to an architect. It embodies all data essential to preliminary sketches.

2. A standard form upon which the employed architect in conference with the local school authorities can record tentative agreements upon all data essential to working drawings and specifications.

3. A checking chart and score card for school-building plans and specifications that will facilitate the problems of state departments of education in reviewing plans, and enable them to make detailed and specific criticisms and recommendations and to approve or reject plans submitted on full knowledge of the facts.

4. Standard requirements for plans of school buildings and sites to be submitted to state departments of education for approval.

5. Approved methods of selecting an architect, together with a standard form for architectural competitions where such are necessary or desirable.

6. Model statutory requirements providing that the control of schoolhousing be vested in the state department of education and obligating such department to formulate a state schoolhousing code and provide for its enforcement.

7. A standard state schoolhousing code embodying modern schoolhousing standards that affect the educational utility of the building and the health, comfort and safety of school children.

The Committee on Schoolhouse Planning of the National Education Association,[5] consisting of representatives of the architectural and engineering professions, submitted a report in 1925 to their organization which emphasizes among other problems the following: the process of planning and constructing a school building; the determination of the schedule of rooms in various types of schools; the choice of the general plan for the school building; the capacity of instruction rooms; the capacity of library and study halls; detecting waste in the plan; the setting-up of standards for safety; and estimating the cost of a school building.

Lighting and Ventilation

There was included in this report an investigation by Freeman[6] on the illumination requirements of school buildings, with the purpose of determining how much light was necessary or desirable for reading, and how the building should be constructed and arranged in order that the required amount of light might be secured. Although the author states that the results which have been obtained thus far are only of suggestive value, his contribution is significant as he points out that even the buildings studied which were constructed in accordance with the prevailing standards of glass area gave deficient illumination in the darker parts of the room under the less favorable conditions of season, weather, and time of day. The bearing which this finding has upon the height of rooms and the cost of buildings is apparent.

The New York State Ventilation Commission[7] has been conducting one of the most significant experiments that has to do with the planning of schoolhouses. Because of the requirements of state law, or as a result of tradition, many thousands of dollars are spent annually on ventilating apparatus in schoolhouses which brings questionable results. The first report of the Commission represents a type of research of which there should be many in the field of education. The conclusion that "in general the Commission was forced

[4] Hart, F. W.: "A Standard State Schoolhousing Code." C. F. Williams and Son, Inc., Albany, N. Y. 1924.

[5] Report of the Committee on Schoolhouse Planning. National Education Association, Washington, D. C., 1925.

[6] Freeman, F. N.: "An Investigation of the Illumination Requirements of School Buildings." In Report of the Committee on Schoolhouse Planning, page 90. National Education Association, Washington, D. C. 1925.

[7] "New York State Commission on Ventilation." E. P Dutton. 1923. See also article on "Current School Ventilation Practices in Typical American Cities," written for THE AMERICAN SCHOOL AND UNIVERSITY by Thomas J. Duffield, Executive Secretary of the Commission (pages 45 to 53 of the present volume).

to believe that window ventilation with ample direct radiation, window deflectors and adequate gravity exhaust seems the most generally promising method for the ventilation of the classroom where local conditions permit its use" cannot be overestimated in its importance. The preponderance of evidence brought forth by the Commission denies the validity of the past standard of 30 cubic feet of fresh air per minute per child, and stresses the importance of the three physical properties of air that are factors in ventilation, namely, temperature, humidity, and the movement of air; expresses the fact that temperature is by far the most important of the three; and that the thermometer is the most important of all of the devices used in ventilation.

McLure,[8] in his study of ventilating practices and ventilating costs in schoolhouses, discovered that in 700 school buildings contracted for between 1890 and 1903, less than 7 per cent used the window gravity method of ventilation and that elaborate centralized systems of ventilation were most frequently installed. McLure found, in a study of 25 cities having 205 school buildings with special mechanical systems, that approximately 50 per cent were not operated every day during the heating season. In many cases, the systems were never operated and in some only a few days each year. In fact, in many cases, the system of ventilation was used merely as an auxiliary system of heating.

Repairs on School Buildings

Schwartz[9] attempted to determine the elements of public school buildings that are most frequently repaired and the relative importance of such repairs. He also attempted to determine the relationship existing among these six factors: size of buildings; average yearly cost of repairs for each building; average yearly cost for repairs for each equivalent classroom; age of building; score of building; and type of building. The value of this study lies in the fact that it makes available to those interested in school-building construction many elements which have important bearing upon the initial cost as well as the after costs of maintenance and operation.

Schwartz pointed out among other things that:

"The chances are ten to one that buildings containing from twenty-one to forty rooms will demand less expenditure per classroom for repairs than the buildings with from two to ten rooms. Similarly, the chances are approximately forty-six to one that buildings scoring over 650 will be less expensive from the standpoint of repairs per classroom than buildings scoring under 650. Buildings under twenty years of age have ten chances to one of costing less for repairs per classroom than buildings over thirty-six years old. These facts indicate that the path of economy lies in the direction of larger buildings, constructed of high-grade material and furnished with service equipment of exceptional operating efficiency. Such buildings demand scientific study and skillful planning if they are to meet to the fullest degree possible the needs of the educational program."

Forecasting Population

Pioneer work in the forecasting of population has been done by public service organizations, especially the telephone companies. Many studies in forecasting school population and determining the location of school buildings have brought such splendid results in economy and adaptation of educational needs that no question can be raised today as to the desirability of the methods in general.

The many surveys made by the Division of Field Studies of Teachers College, Columbia University, have brought to light many detailed problems in the field of forecasting which should be developed. A beginning has been made in this field by Dr. Fred Engelhardt[10] in applying mathematical formulæ to the problems of forecasting. This work is in large measure based upon the fundamental studies made by Dr. Raymond Pearl[11] in allied fields.

Insuring School Property

Property values may be completely destroyed by fire, lightning, windstorm, earthquake, explosion, or collision, and the like. By far the greatest losses are due to fire. Wentworth[12] reports that, in the United States, every day five schoolhouses burn. Melchior,[13] in his study of fire losses in 86 per cent of the school buildings in New York State, shows that ninety-one fires were reported as having occurred during the period January 1, 1915, to December 13, 1920. Thirty-eight, or 42 per cent, of these fires were total losses. Two-thirds of these were in the rural districts of the state; 14 per cent were in the cities. There were fourteen lightning and seven windstorm losses reported during this same period. The property losses in this state reported to be due to fires which occurred during the five-year period prior to 1920 were $1,015,295. Challman[14] reports a total of 221 fires in Minnesota for the nine-year period, 1915-1923, representing an average of 24 fires per year, an aggregate loss of $2,624,627 and an average yearly loss of $291,625.

Studies in the field of insurance have shown that school boards are compelled to pay a much higher rate on certain types of buildings than the actual findings would justify. Often, a school district pays the same premium rate on all of

[8] McLure, J. R.: "The Ventilation of School Buildings." Bureau of Publications, Teachers College, Columbia University. 1924.

[9] Schwartz, H. M.: "Improvement in the Maintenance of Public School Buildings." Bureau of Publications, Teachers College, Columbia University. 1926.

[10] Engelhardt, Fred.: "Forecasting School Population." Bureau of Publications, Teachers College, Columbia University. 1925.

[11] Pearl, Raymond.: "Rate of Growth of the Population in the United States Since 1790." National Academy of Science, Vol. VI, June 6, 1920.

[12] Wentworth, F. K. National Fire Protection Association, page 1. Bulletin, 1923.

[13] Melchior, W. T.: "Insuring Public School Property." Bureau of Publications, Teachers College, Columbia University. 1925.

[14] Challman, S. A. Mimeograph Bulletin on Fire Losses. Department of Education, St. Paul, Minn.

its school buildings, although some of these school buildings may be utter hazards and others fire-resisting or actually fireproof structures. Melchior has pointed out that insurance companies have not set up special schedules for schoolhouses as they have for other special types of community houses, and that there is considerable question concerning the methods employed in insuring school property. As the loss to a community is far greater than the building itself when a school structure is destroyed, further studies are required which will make clear the preferred procedure with respect to the insuring of school properties after they have once been constructed.

Why Are School-Building Costs High?

The Joint Legislative Committee on Economy and Taxation of the Ohio State Association of Architects has recently prepared a very significant study entitled "Excessive School Building Costs—Causes and Remedies." They point out five chief causes for high building costs for schools at the present time: (1) the war; (2) labor conditions and material combined; (3) the state building code; (4) careless planning; and (5) ineffective use of buildings. Under *the state building code,* they found as the chief reasons for high costs, such items as the requirements of room sizes that unnecessarily increase the size of the building, unnecessary and restrictive ventilation regulations, excessive number of toilet fixtures, and smoke screens required at all stairways.

The architects, in conjunction with school authorities, made careful studies of some of these problems. The method employed by them with reference to the number of toilet fixtures was as follows: Twenty schools were selected and for several days the number of pupils entering the toilets during the day was recorded. By this method, it was determined that during the morning recess period occurred the peak use of these rooms. A count showed in the case of boys' toilet rooms in the various high schools that the number of boys enrolled was 7,100. The number of water-closets was 280. The maximum number used at one time was 16. The waste of money here was obvious and very large. It is desirable that many more studies of this same type be made to insure the greatest economy in the plumbing installations in schoolhouses.

Thomas[15] has pointed out that "strange as it may seem, manufacturers do not make a line of plumbing goods especially designed for public schools. They have fixtures designed especially for hospitals, apartment houses, factories, industrial plants, homes, public comfort stations and jails, and from these the school administrator, with such advice as may be available, must choose those he considers nearest fitted to the needs of the school."

Thomas, in his study of standards for school plumbing, found that both lavatories and stools are too high for the children who have to use them, that the stools are not adapted to the anatomies of children, and that many of the characteristics of the present-day school plumbing must be changed radically if the program of health and physical education is to be advanced significantly.

It is obvious that all school buildings must be divided into spaces in which classes of various sizes are taught the various subjects or are permitted to develop the various social and physical programs which are such a large part of the present-day curriculum. Very many significant questions of teaching efficiency and of building utilization are immediately raised when any new school building is being planned. Whether the gymnasium is to be built for classes of 50, 100, or 200 pupils; whether the auditorium capacity will be 500, 1,000 or 2,000; whether shops are to be developed to care for 15, 20, or 25 students; and whether the regular classrooms are to house 25, 30, or 40 pupils, have afforded the opportunity for much free expression of opinion. As yet, the experimental evidence is not available which will permit of the final decision in many of these fields.

The Relation of Class-Size to Efficient Teaching

Stevenson[16] has made significant studies with reference to the relation of class size to the efficiency of teachers. He states that:

> "The best information we have concerning the size of classes in the United States at present is that the median elementary class contains 38 pupils, the median junior high-school class, 28 pupils, and the senior high-school class, 25 pupils. This, of course, means that there are as many classes larger than these medians as there are classes smaller than the medians. The general opinion among educators is that the size of classes should be reduced; but, as between types of schools, the trend of opinion corresponds in general with the common practice of having the largest classes in the elementary school, smaller classes in the junior high school, and the smallest classes in the senior high school.
>
> "The problem of class-size has interested students to such an extent that several investigations of it have been attempted. These have produced results which, while conflicting, have tended to show that the size of a class is not a determining factor in efficiency of instruction."

His experiments have brought to light that, on the whole, small classes are a little more efficient than large classes in elementary schools, and that the small classes are of less advantage to the average and bright pupils than to the dull pupils. He also shows that in high schools the smaller classes have a very slight advantage over the large class. He points out many of the difficulties encountered in this and many other studies which he has made and emphasizes the importance of further investigations along this line.

[15] Thomas, M. W.: "Plumbing Standards for School Buildings." Bureau of Publications, Teachers College, Columbia University. 1928.

[16] Stevenson, P. R.: "Smaller Classes or Larger: A Study of the Relation of Class-Size to the Efficiency of Teaching." Public School Publishing Co., Bloomington, Ill. 1923.

Utilization of School Buildings

Morphet,[17] following the work of Packer,[18] undertook the problem of measuring and interpreting the various aspects of school-building utilization. He indicates that the tremendous increase in high-school enrollment during the past decade has brought a host of serious building and housing problems.

> "In an attempt to provide adequate facilities for this rapid growth in student population, the available resources in many communities have been taxed to practicable limits. Other communities, not being able or willing to provide additional housing, have resorted to half-day sessions, staggered schedules, or various other emergency devices designed primarily to increase the capacity of apparently congested buildings."

His studies, like those of the National Education Association Committee on Schoolhouse Planning, have indicated a very low percentage of utilization in schoolhouses which are, in many cases, considered to be congested by the school authorities themselves. His percentages of room and pupil-station utilization computed for each of 58 secondary schools show that during class periods only 75.4 per cent of the rooms and 41.1 per cent of the pupil stations are used in the average building. This author indicates that:

> "Percentages of room utilization for any type of room may be greatly influenced by certain factors, chief among which are: degree to which the building is adjusted to the educational program, the physical desirability of rooms, the type of equipment, whether rooms and equipment are used for other purposes than those for which they were primarily designed, efficiency of schedule making, type and number of periods in the schedule, and type of schedule.
>
> "Percentages of pupil-station utilization may be influenced by any of the above factors and are particularly likely to be influenced by the following: size of room, relationship of present equipment to maximum, and efficiency of adjustment of classes to rooms."

Thus, Morphet brings to light many problems which are crying for solution, as they are so closely related to the problem of securing a full return from the investment made in school-housing.

Special-Service Rooms

A few studies have already been made which are concerned with the amount and character of the space to be devoted to special-service rooms in school buildings. Among these, Ford's[19] analysis of high school cafeterias is outstanding. Ford sets up formulæ for the prediction of the number of student patrons in schools of various sizes and under the various methods of lunch-room administration. He has determined the space and room requirements. He has reduced the serving-counter requirements to a formula, has indicated the types of equipment for cafeterias of various sizes, and has estimated that the budget for cafeteria equipment, furniture and fixtures should be $35 per dining-room seat.

Not only should buildings and grounds be designed and constructed for multiple use, but laboratories and special rooms likewise. In planning the facilities for a small high school, multiple use is especially desirable. An interesting illustration of multiple use of special rooms may be found in the more recent designs of equipment for science laboratories.[20] Packer,[21] in analyzing room requirements of high school programs, points out that:

> "Specially equipped rooms which preclude other than one-purpose use, result in tremendous waste even in large schools. In the schools with small enrollments, it would be practically impossible to justify the loss due to this factor. Every effort should be made to reduce this loss by planning for the largest maximum combination use possible."

Economies in the Planning of Schoolroom Equipment

An illustration of economies which are possible in the equipment of schoolrooms is taken from the study made by Hart and Peterson[22] covering the use of blackboard space in regular classrooms. It has been the usual custom to line classroom walls with blackboards which cost from 60 cents to $1.25 per square foot. These investigations point out that in 102 rooms, or 35 per cent of the total involved in their study, only 11 to 20 pupils were reported as using the blackboards at any one time. The total blackboard installation costs were approximately $25,000. A large part, therefore, of this cost could have been saved in the initial installation.

In the past few years, there has been much discussion in the medical journals of the value of the light rays that do not pass through the ordinary window glass. Some time ago, a new glass came upon the market for which the claim is made that it is penetrated by the ultra-violet rays. It is indeed possible that by shutting children up in a building five hours a day we have robbed them of a health-giving element. As long as we do not know the truth of this, research is imperative in this matter. Carefully controlled groups should be observed in rooms fitted with ordinary glass and with all the special glasses the market offers, and the effect, if any, should be determined. Thus educational research finds it necessary to consider not only the space requirements and the equipment of a structure, but even the materials of which a schoolhouse is made.

[17] Morphet, E. L.: "Measurement and Interpretation of School Building Utilization." Bureau of Publications, Teachers College, Columbia University. 1927.

[18] Packer, P. C.: "Housing of High School Programs." Bureau of Publications, Teachers College, Columbia University. 1924.

[19] Ford, W. S.: "Administrative Problems of the High School Cafeteria." Bureau of Publications, Teachers College, Columbia University. 1926.

[20] Glenn, E. R. and Others: "A Description of the Science Laboratories of the Lincoln School." Bureau of Publications, Teachers College, Columbia University. 1925.

[21] Packer, P. C.: "Housing of High School Programs." Bureau of Publications, Teachers College, Columbia University. 1924.

[22] Hart, F. W., and Peterson, L. H.: "Economies in Schoolhousing." The American School Board Journal, page 42, July, 1926.

Efficient Size of School Plants

One of the most important problems confronting the school administrator has to do with the size of the school plant. In one city which is building schools with a capacity of 5,000 children, when the principals were asked concerning the outside figure for successful administration, they placed it at 3,000 pupils, while most of them considered 2,500 pupils the ideal maximum. Irrespective of this judgment, a number of schools are being erected costing millions of dollars with capacities far in excess of these amounts. In some instances, these large city high schools are planned so that they represent glorified village high schools. In other words, the allocation of spaces does not differ from that of the small school, but the spaces are increased in size, making travel distances enormous, increasing the time to be utilized in passing, and raising many questions involving the health, fatigue, and nervous strain upon teachers and pupils. Research should be undertaken to demonstrate whether the excessively large school should be built in the future, how it should be built, and how its organization should be subdivided so as to secure the best results for all concerned.

Many new studies are in the offing. Some of them are concerned with the size, equipment and use of playgrounds, others with the adaptation of the school building to the changing program growing out of the recent significant measurement and curriculum developments, and still others are based upon the suggestion that the very nature of school buildings may be fundamentally changed as our teaching knowledge and methods progress. It is highly important that much more time and money should be devoted to these educational needs than have been made available in the past.

Selling School Bonds

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ABOUT $300,000,000 worth of school bonds have been sold in the United States each year for the past few years. Have these bonds been sold to the best advantage? To answer this question we need to know the rate at which the bonds have been sold. To determine whether the bonds were sold to the best advantage, school officials should have the Index of School Bond Prices* for comparison.

A brief study of the school bonds being sold at the present time will show any one that many school officials are not using expert information in selling school bonds. In any recent month bonds of school districts which are much the same financially have sold at net interest rates ranging all the way from 3.60 per cent to 5.00 per cent. When one school district sells bonds on a net interest basis of 3.75 per cent and a similar district pays 4.25 per cent, something is wrong. Each month situations as bad as or worse than this can be found. The state laws are responsible for some of the difference in the price of bonds, but a large part of the difference is due to the failure of the school officials to sell the bonds to the best advantage. Unfortunately, many times the school officials think they have sold the bonds to good advantage, but as they do not know what bonds should sell for, they do not realize that they have not obtained a good price.

Bonds that have been sold in the past are closed issues, and all that school officials can do is to see that future sales are made to the best advantage. To do this it is necessary for the school officials to know two things:

1. How to get the highest possible bids on the bonds to be sold.
2. How to know that the bids are as high as can reasonably be expected.

Space does not allow a detailed discussion of methods of getting bids. It is sufficient to say that the bonds should be advertised, not only locally, but also in such a way that bids will be received from one or more of the large bond houses. As these houses know the current selling price of bonds, the schools have fair prospects of at least good bids from them. Some of the smaller banks and bond houses will offer a low price for the bonds if they think there will be no competition and that the bonds can be bought at the low price.

The duty of the bond house or bank, even the largest or most conscientious, stops at offering a fair price for the bonds at the particular time they are offered and under the conditions offered. The duty of the school officials includes seeing that the bonds are offered at the time and under the circumstances that will bring the highest price for the bond and the lowest net interest rate.

How to Know the Best Bid

Let us assume, then, that the school officials have so chosen the time to issue the school bonds and have so advertised that the best possible bids have been secured on the bonds. How are the school officials to know that the bid is the best that can be expected? The school officials cannot spend all of their time studying general financial conditions and the specific factors affecting the price of school bonds. Even if they spent a large

* Appearing monthly in *American School Board Journal.*

part of their time studying such factors, they would probably overlook some very important ones. There are many types of financial facts which they could not have readily accessible. For these and other reasons it seems evident that, if the school officials are to have the information they need, it will have to be supplied in a fairly simple form and with the conclusion obvious. The best method of presenting this information seems to be in the form of index numbers. For this reason the following index number of school bond prices is given as a sample of the material that should be available to school officials at all times.

AVERAGE NET YIELD OF ALL SCHOOL BONDS SOLD DURING THE MONTH

1928		*1927*	
July	4.45	December	4.27
June	4.42	November	4.28
May	4.35	October	4.50
April	4.13	September	4.58
March	4.18	August	4.67
February	4.26	July	4.55
January	4.29	June	4.52
		May	4.43
		April	4.41
		March	4.46
		February	4.43
		January	4.71

Such an index should enable the school official to find out when the bonds have been sold to good advantage. Proper advertising should make it possible to sell the bonds to good advantage. Even though the bonds have been well advertised and sold to good advantage and the school officials know they have been sold to good advantage, there are many things the school officials should have watched even before deciding on the form of the bonds. We shall call attention to only two of these things.

Two Very Important Points

The school bonds should be callable. A provision should be inserted stating that the bonds can be retired after a certain minimum number of years. The purpose of this is, if there is a substantial fall in interest rates, the bonds can be recalled and new bonds issued at the lower interest rates. There are hundreds of millions of dollars of school bonds outstanding with interest rates of 5 per cent or more, issued from 1910 to 1922. Most of these bonds could be issued around 4 per cent today. But the bonds are not callable and as a result the communities will pay the extra one per cent each year until the bonds fall due. In many cases this will be 20 or 30 years. One per cent for 20 years is 20 per cent of the face value of the bonds. This is a fearful price to make the public pay because of the carelessness or lack of information on the part of the school officials.

The second factor to which we shall call attention is the use of short-term loans in school financing. There are times when school officials must have money for building or repairing purposes, and must have it more or less regardless of the current rate of interest. In such circumstances there is no reason why school officials should not follow the practice of the United States Treasury and issue short-term certificates.

As Secretary Mellon says, if interest rates are temporarily high when the United States Government needs money, it is the policy to issue short-term notes or certificates until more favorable interest conditions appear. This practice is followed to a very limited degree by a few of the larger cities. There is no reason why it should not become common practice with school districts. It is much better to pay the high interest rate for a short period than for a long period. There is a further advantage in that during most of an average year interest rates on short-term loans are lower than rates on long-term loans. If the Federal Government needs to save money by this process, surely the need is no less pressing on the schooi district.

Because of limitation of space it will not be possible to give more detailed consideration to the two factors mentioned above. For that reason we shall pass on to a summary of a few important items. The school officials should go over the following checking list to make sure that at least these minimum essentials have been observed in issuing bonds. It is assumed that the amount, kind, and size of the bond issue have been properly determined in the light of the needs of the school district. It is also assumed that proper investigation has been made into the cost of building at this time. It is further assumed that all the legal provisions in regard to issuing bonds have been carefully fulfilled.

The Minimum Essentials

1. A check should be made against the Index of School Bond Prices to see that the proposed interest rate on the bond issue is as low as it is possible to obtain at the time of issue.

2. A check should be made of the rate of interest on school bonds for the past few months on the Index and the probable rates for the next few months and a decision made from these facts as to whether it is a good time to issue long-term bonds or whether short-term loans should be issued until a more favorable time comes to issue long-term bonds.

3. A check should be made in order to discover and take advantage of any possible seasonal variation in interest rates.

4. A check should be made to find out whether there is any part of the month to be avoided because of commercial demands for money that would tend to make less money available for school bonds and thereby prevent the bonds from selling at the best price.

5. A check should be made to see that the bond issue has been so advertised that it will be possible to get the full advantage of having determined the proper time to sell the bonds.

If these few things are done, the result will be a saving of large sums of money on school bond issues.

Surveying Future Catholic High School Requirements

BY FRANCIS M. CROWLEY

DIRECTOR, NATIONAL CATHOLIC WELFARE CONFERENCE BUREAU OF EDUCATION

BETWEEN 1915 and 1926, Catholic secondary schools increased in number from 1,276 to 2,242, and the number of pupils enrolled from 74,538 to 204,815. This rapid growth has brought many problems in its wake, not the least of which has been the provision of adequate facilities. It was an easy matter to care for students under the old régime of secondary schools controlled by religious orders, schools in which a large proportion of the students were boarders; but with the spread of the doctrine of universal secondary education, and the rise of the central Catholic high school movement with its doctrine of tuition-free schools, many problems of a troublesome nature confronted diocesan school officials. When the doctrine of universal secondary education received approval in church circles, it was only to be expected that Catholic school officials would come to view the provision of adequate facilities as a diocesan responsibility—one transcending parish lines.

In the large centers of population the central Catholic high school, drawing its students from forty or more parishes located in adjacent territory and supported by assessments on the parishes sending students to the central school, was soon resorted to as the administrative unit to be employed in caring for the increasing number of students seeking secondary education under Catholic auspices. It is generally claimed for the central Catholic high school that it pools resources with resultant financial economy, provides an efficient unit of administration, promotes teacher economy, secures well-trained teachers for special subjects, offers a variety of courses, guarantees accreditation, and provides better opportunities for socialization. In 1922, central Catholic high schools cared for 5.5 per cent of the students in all Catholic secondary schools, but by 1926 they were caring for 17.3 per cent. The parochial high school has given way to the central high school, since the latter is generally recognized as the administrative unit that lends itself most readily to the solution of the Catholic high school problem.

The Value of the School Survey

Social surveys have been employed extensively in Catholic circles in mapping out programs for the administration of diocesan charities. The parish school, drawing from a parish which is as well defined territorially as any elementary school district in a public school system, furnished no such problem as the new central Catholic high school. It was only natural, therefore, that church officials, cognizant of the value of the social survey, should turn to the school survey as a means of securing objective data on such matters as the social and economic status of the Catholic population, the center of Catholic population, population trends, the extent of facilities to be provided, and the territory served by schools in existence. So many other factors were also involved, such as, the type of parish assessment to be employed in raising funds for the erection and support of new high schools, allocation of territory for private secondary schools in existence, teacher supply, courses of study needed in the community, etc., that the high school survey presented itself as the only feasible solution. The first Catholic high school survey was conducted in the Archdiocese of Milwaukee in 1926. A similar comprehensive survey was staged in the Diocese of Cleveland early in 1928. The Milwaukee Survey covered only the high schools in the city of Milwaukee, while the Cleveland study included those in the cities of Cleveland, Akron, Canton, Youngstown and Lorain. Eight high schools enrolling some 2,000 pupils entered the first survey, while over forty secondary schools caring for approximately 5,000 students were included in the second.

The term "survey," as it is commonly understood, may apply "to the study of an entire school system, or to any single part of the system or problem within the system." Here we are concerned particularly with the building program, yet for proper guidance such a large amount of data must be drawn from other divisions usually included in a comprehensive school survey, that we must at times necessarily discuss other phases. The school survey may be described as "a careful factual study of educational conditions and results together with constructive criticism of the findings." In other words, the purpose of a survey is to find the facts and to interpret them. It goes beyond saying that the survey must have a clear and definite purpose, that the methods of study employed must be scientific, and that its prescriptions regarding the future must be definitely constructive. There are four main aspects of a school survey: (1) to determine the type of educational program needed by the community and how the present organization is satisfying these needs; (2) to prepare a careful analysis of the financial status of the Catholic community so as to determine its ability to finance proposed ex-

tensions; (3) to make a thorough inventory of present school facilities to determine their efficiency in the light of the functions to be performed; (4) to outline a constructive program for the present and future and to suggest means of financing it.

Organizing the Committee Work

As soon as the objectives for the survey have been clearly thought out, a skeleton outline of the work to be done by the members of the survey committee must be prepared. Such matters as providing clerical help, furnishing transportation for members of the survey committee while in the field, making hotel reservations, distributing and collecting questionnaires, requesting class schedules and courses of study, suggesting methods for the tabulation of data, enlightening principals on the purposes of the survey, approving expenditures, etc., naturally are cared for by the director or chairman of the survey committee. He will also be responsible for the preparation of the outline referred to, taking every precaution to avoid overlapping and conflicts in the work assigned to each member. He must also guard against the collection of irrelevant data and the natural tendency of some surveyors to shoot off on a tangent; that is, to engage in work which has no direct relation to the objectives of the survey. He must also exercise care in collecting and using data, since all sides of the case must be presented. He cannot afford to have the findings or recommendations of the members open to question on the score of prejudice. Opinions must not be substituted for facts, samples of data must be representative, and where comparative methods are used there must be sufficient basis for comparison. No small part of the work of the chairman will consist in smoothing out misunderstandings, urging the completion on schedule of the various sections of the report, guarding against undue publicity which may prejudice the public or school officials, keeping the surveyors in touch with the progress of the work, and caring for unforeseen developments while the field work is under way.

In the Cleveland survey each member of the committee was supplied with the following a few weeks before the field work was undertaken: (1) maps showing the locations of the high schools in the cities included in the survey; (2) a class schedule and course of study for each school; (3) an outline showing the work required in each division. Each member was also informed as to the approximate date the work would be undertaken and the possible date of completion, with the date, place and hour for the general meeting to be held on the opening day of the field work.

The work in Cleveland was conducted under six division chiefs, each responsible to the director in turn for the proper conduct of the work of his section. The six divisions were as follows: (1) Cleveland's Catholic High School Problem, covering efficiency of present school facilities, population trends, future school population, social and economic status of Catholic parents, per capita costs, retardation, age-grade status, mortality, and future school-building program; (2) Tests and Measurements, including the administration of intelligence and achievement tests in the high schools and the upper grades of representative elementary schools; (3) Efficiency of Supervision and Teaching, covering classroom visitations, employment of standard score cards and consultations with principals and supervisors; (4) Teacher Training, involving an evaluation of the experience and training of teachers, determination of the standing of teacher training institutions reported, and consideration of the teacher supply for new schools to be recommended; (5) Curriculum, including an evaluation of the present courses of study in the light of student and adult needs, provisions for vocational and educational guidance, and extra-curricular activities; (6) Libraries, covering an evaluation of present facilities, cooperation with public libraries, and encouragement of student reading.

In considering the foregoing outline, it must be borne in mind that it is not an ideal plan, since many modifications were called for because of the specialized training of certain members of the committee. For instance, libraries could easily form a subdivision in the curriculum section. Again, a special division might easily have been created for guidance or student accounting. Adaptation to the training of the personnel available governed the allocation of the work to some extent, but there was no confusion because of this. In the discussion under "Cleveland's Catholic High School Problem," for instance, separate chapters will be devoted to per capita costs, mortality, age-grade status, social and economic status, future building program, etc. Moreover, the conclusions and recommendations will be summarized at the close of each chapter and then brought together in a section devoted exclusively to them at the end of the report.

In the conduct of both surveys, the testing program was staged at least three weeks in advance of the field work of the other divisions. The purpose in doing so was to cause as little disruption of the regular school programs as possible. Some weeks before the field work, a letter was sent to each principal and teacher giving detailed information on the survey. Students in the high schools and the upper grades of the elementary schools were required to fill out questionnaires calling for information on (1) father's occupation, (2) telephone in home, (3) grades skipped and failed, (4) number of brothers and sisters and number in public high schools, (5) future plans, (6) subjects liked and disliked, (7) work outside of school hours, (8) persons or factors responsible for future plans, (9) national origin of parents, (10) ability to meet tuition charges, (11) elementary school attended, (12) distance traveled to school. On forms prepared for the purpose, principals were requested to supply age-grade and mortality data, the present whereabouts and the

marks of graduates for the two preceding years, outlines of vocational and educational guidance programs, and the names of textbooks in use. The librarian of each school was required to fill out a detailed questionnaire covering every phase of school library service. Each teacher filled out a form covering his training, experience, professional reading, outside duties and future plans. All forms were available for examination by members of the survey committee before the inauguration of the field work.

Progress of the Field Work

As soon as the field work gets under way, frequent conferences of the division chiefs are held, usually at the close of the day's work, so that unusual developments may be discussed and a visitation program mapped out for the next day. Here again, in order to guard against undue interference with school programs and loss of time, the surveyors responsible for the curriculum, building, and per capita cost sections do not visit the schools together. Conferences with the principal are so frequent during such visits that if this precaution is not taken, conflicts are bound to arise. In order to render all data objective, Strayer-Engelhardt score cards are used throughout. These furnish a splendid check on the efficiency of buildings and instruction, and in the case of teachers furnish, when supplemented by the findings of the tests and measurements division, some excellent material to guide the surveyors in bringing forward recommendations looking to the betterment of instructional procedure. As soon as the field work is completed, data gathered through questionnaires are supplied to the members of the committee in tabulated form from the central office, with outlines showing the general plan to be followed in preparing the reports of the various divisions. Conferences are held as soon as all reports are filed, to do away with conflicts and to discuss the general recommendations, particularly those dealing with the future building program.

In order to give proper consideration to the building program, an examination must be made of the educational needs of the diocese, the efficiency of present facilities, and the ability of the diocese to care for its educational needs. In the definition of educational needs, wide use must be made of the findings of the section on the curriculum. The character of the school plant will depend largely on the type of organization suggested and the nature of the curriculum. Its extent will in large part be governed by the number of children to be educated. The location of the new buildings will depend on the distribution of the Catholic population, accessibility, freedom from noise, and space available.

The first step is to determine the capacity of present school buildings and the reasons, if any, why buildings are not operating at capacity. In some cases this will be due to high tuition rates, in others to inaccessibility, and in still others to the course of studies. The growth of all high schools must be plotted for a period of at least ten years, and the drawing power of individual schools determined from the students' questionnaires. Some schools draw from local parochial and public schools only, while others attract students from remote places and in numbers large enough to indicate that the usual attendance barriers have no effect. It is usually not much of a task to define the territory from which a school draws or to indicate the possibilities for future expansion. Schools situated near the center of a city, or conducted under parish auspices, usually draw from a rather limited territory. Yet again, other factors enter in, such as the selective character of a school due to a high tuition charge. A school in this class is usually neglected as a factor in the solution of a diocesan high school program. In some cases it will be possible to relieve the pressure in certain districts through additions to the present plant. The drift to public schools and the reasons given for attendance also give a fair index as to lack of facilities. The distances traveled to school give some indication of conditions also.

In Milwaukee the data taken from the pupils' questionnaires showed very clearly that there was a lack of high school facilities for boys in one section of the city. The school for boys supposed to serve the section was poorly located. It was an easy matter to plot the center of Catholic population in the district in question, allow for growth in the direction of the population trend for a period of years, and then indicate the capacity and approximate location of a new school for boys.

Estimating the Future School Population

The task of determining the number of children to be cared for in Catholic secondary schools during the decade following the survey is an extremely difficult one. It calls for ingenuity and resourcefulness of the first order, and at best the results can be considered only as approximations. The first step is to collect from the Chancery Office a record of births and deaths for a period of ten years. By a rather involved process it is then possible to estimate the probable number of children in Catholic and public schools. Allowance must then be made for the normal growth in Catholic population during the next decade, and for the usual increase in the number entering Catholic high schools when additional facilities are provided. The normal rate of continuance into high school—easily procured from the parochial school principals—plus the increase due to the provision of additional facilities, gives us the rate to be used in determining the number of secondary school students during the next decade. At times it is necessary to check the results against the rate of continuance into public high schools. Provisions must of course be made in such estimates for mortality, deaths, transfers, etc. If a recent census of the Catholics in the city

or diocese is available, it will not be necessary to employ such an involved process to determine the expected Catholic secondary school population.

The total indicating expected secondary school population is then compared with that showing present student capacity, and the difference shows roughly the number of students that must be cared for by the erection of new buildings or annexes. Data on population trends, collected from real estate operators, public utility corporations, public school research bureaus, and chambers of commerce, must now be consulted in order to indicate the approximate location of new buildings. Data on new parishes created during the last decade will show the real estate developments in which Catholics are purchasing homes. This can be checked against the social and economic status of parents as determined from students' questionnaires, since it is an axiom amongst real estate operators that property values serve to segregate as effectively in subdivisions as other factors do in other spheres of life. The student capacities of the new buildings will then be largely determined by the drift of families into newer real estate developments and the ability of the present plant to care for student needs.

The Score Card Method

In evaluating the efficiency of present facilities, the score card method is employed exclusively. The Strayer-Engelhardt Score Card for High School Buildings was used in both surveys referred to here. Weaknesses in various departments, in so far as lack of adequate facilities is concerned, are brought to light in short order. The inadequacy of certain buildings as school plants is patently evident when contrasted with the scores for other buildings which may in themselves be only partly efficient units. Fire hazards, poor location of buildings, lack of recreation space, remediable conditions such as overcrowding, etc., become objective realities when the scoring is completed. With such an inventory of the present plant available, it is a comparatively easy task to indicate the schools that must be abandoned, altered or provided with additional seating capacity. These recommendations will naturally influence the building program; that is, in so far as new buildings are concerned.

How Is the Diocese Meeting Its School Needs?

The ability of the diocese to meet its educational needs may be determined in a number of ways. First we must consider the Catholic family, or the ability of the Catholic parent to pay for the secondary education of his child. Here we find a wide variance in conditions; marked contrasts between returns from different sections of a city. In the first class we find parishes where the returns from the students show that the parents' occupational status is largely professional, managerial or personal service, while in the second the semi-skilled and common labor groups include the largest percentage. All things else being equal, it is evident that if enough parishes in the first class can be found in one locality to support a central Catholic high school, a nominal tuition rate may be charged, but it is equally clear that free tuition must be provided in schools serving parishes in the second class. The occupational status of parishioners, therefore, gives some clue as to the ability of the constituent parishes of a diocese to bear the expense of a high school extension program.

Additional data that will influence the recommendations of the surveyors, on the score of nominal-tuition or tuition-free schools, will be furnished by the students in the number of brothers and sisters reported. In the Milwaukee Survey the average number of brothers and sisters was five, and the Cleveland returns indicate the same high number. The range in each case was from one to thirteen. It is manifestly impossible for any parent, particularly in certain occupational groups, to pay even a nominal tuition fee when five children must be clothed and fed. Tuition-free schools must be the order of the day where such conditions are found.

If a diocesan drive for a high school building fund is not contemplated, the best way to determine the capacity of the constituent parishes to defray a high school building program is to secure from the Chancery Office a statement of present debt, income and annual expenditures for a period of ten years for each parish in the diocese. An average of the income for the decade, with allowance for current debt, gives an equitable basis on which parish assessments may be made for the creation of a central building fund. The approximate cost of the proposed building program will of course be determined in advance.

When the findings under the three heads—educational needs, efficiency of present plant, and ability to pay—are brought together and correlated, we have a skeleton outline for a building program. All recommendations must, of course, be open to such modification as may be dictated by the findings of the other divisions of the survey, particularly of the section dealing with the curriculum. It may be well in closing to say that the last step is the preparation of an elaborate map showing the locations of parochial schools and high schools in existence; attendance barriers, such as valleys, rivers, railroads and parks; and the approximate locations of new high schools. This will be accompanied by charts presenting supplementary data in graphic form.

Practical Suggestions on the Artificial Lighting of School Buildings

BY A. L. POWELL
ILLUMINATING ENGINEER

ARTIFICIAL lighting should be provided for all schools. Even where most of the school work is done during daylight hours, there are inevitable cloudy or stormy days which necessitate supplementary lighting. It is little realized how much of the day is spent in semi-darkness. In December, for example, there is an average of only five hours of sunlight per day. In the vicinity of New York, cloudy days comprise approximately 40 per cent of the school year. Obviously, artificial lighting of the proper kind must be provided, in order that the children's eyes may be protected and school work carried on in a satisfactory manner. Artificial lighting must receive special consideration, for a satisfactory combination of natural and artificial light is one of the most exacting problems. Moreover, during the past few years school buildings and rooms have been used to an increasing extent at night, making good lighting a requisite.

That defective vision is acquired and is often progressive, is shown by the fact that eye troubles are more prevalent among children in the advanced grades. In most cases the child receives his first exacting eye work when he goes to school, where, of necessity, a large quantity of printed and written matter is placed before him. It can be easily understood how a child born with normal vision, but forced to do detailed work oftentimes under inadequate illumination, develops poor vision. Indeed, it is difficult to appreciate the value of education, if, in acquiring it, one must also acquire poor eyesight to limit its application. It is essential that good illumination be provided in the schools so that those pupils whose eyes are normal may see properly, and that those with defective vision may do better work.

The American City Bureau reported a few years ago that the average cost of teaching each child per year was $57. The average child will reach the eighth grade at the age of 14 years at a cost of $456 to the state. If, on account of defective vision caused by poor illumination, or slowness due to lack of visual stimulus, the child reaches the sixth grade only, the cost to the state has been the same, with only three-fourths the result. The state loses money, and the child will probably leave school poorly prepared to earn a living. At a cost of only $1.50 per child per year, good illumination, which would tend to decrease greatly eye troubles and resultant backwardness, can be provided.

In the majority of schools arrangements for daylight are generally satisfactory, but the artificial lighting is frequently inadequate. Systems in use often consist of bare, clear incandescent lamps, and, where reflectors are used, they are frequently hung in such positions as to cause eyestrain. In many cases suitable luminaires, properly located, are provided, but the level of illumination is far too low, because lamps of too low wattage have been used.

Proper school illumination is so important in ensuring future public health and visual power that various welfare and educational associations have taken an intense interest in improving the practice and in preventing the exposure of school children to eyestrain, which has been altogether too common in the past.

In 1918, the Illuminating Engineering Society, 29 West 39th Street, New York City, which had already proposed an industrial lighting code, issued a Code of Lighting School Buildings, setting up minimum standards of schoolroom illumination. The state of Wisconsin and the Department of Education of the state of New York adopted regulations based thereon.

The essential features are the standards for adequacy of illumination and for the elimination of glare. The rules are accompanied by helpful suggestions and detailed explanations of factors affecting illumination. As a result of wide distribution of the code by the Illuminating Engineering Society, welfare organizations, and certain governmental bureaus, there has been a growing appreciation of the importance of proper illumination on the part of the school boards, and a marked improvement of practice. Nevertheless, there are still many schools where pupils are exposed to conditions which are undoubtedly injurious to vision and likely to decrease the future earning capacity of the victims.

General Considerations

It is self-evident that a suitable amount of light must be supplied in all parts of the school if the various types of work are to be performed properly. Correct illumination is necessary in order that everything which is to be seen may be seen clearly and without eyestrain. Regardless of what type of lighting system is used, a sufficient amount of light must reach the work, otherwise the system must be considered as being inadequate and unsuitable.

The most important part of the school building is, of course, the class and study rooms, and on account of the limited space available we must

confine our attention largely to these working areas, giving but a passing thought to the other parts of the building.

At the entrance and in the main corridors the artistic element of the fixtures is important, and the architect will, in general, make sure that pleasing designs are chosen entirely adequate for providing the necessary amount of light.

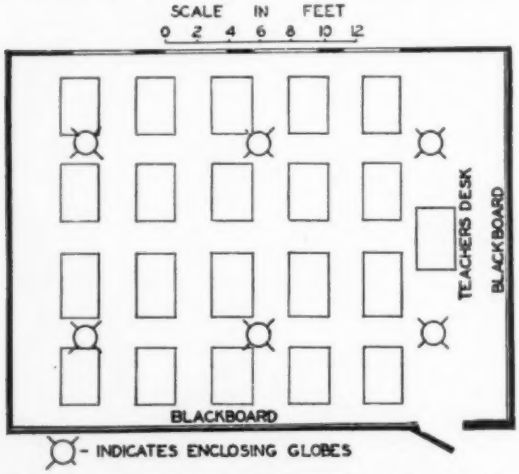
In the auditorium, also, decorative fixtures find application and equipment should be chosen in keeping with the character of the room, but the mistake should not be made of allowing the daytime appearance of the fixture to outweigh its illuminating qualities in the way of reducing glare and distributing the light properly. In general, a level of illumination of from 3 to 6 foot-candles should be provided in the auditorium, although in cases where the auditorium is used for study purposes also, the level should be that of classrooms of from 8 to 12 foot-candles.

Simple, efficient, sturdy types of equipment should be installed in the secondary corridors, cloakrooms, etc., so placed as to illuminate the entire area and fitted with a size of lamp that will give from 2 to 4 foot-candles of illumination as an average value.

In the laboratories, manual training rooms, gymnasium, and service rooms the types of equipment used in the industrial plant prove effective, although with certain designs of gymnasium special requirements are presented.

Lighting of Classrooms

All too frequently those having the matter in charge tend to spend a large portion of the appropriation for lighting fixtures on the parts of the building where the greatest showing is made —entrance, auditorium, etc. It is not uncommon to find solid bronze fixtures here with the most elaborate fittings, and then see in the classroom, the most important part of the whole building, if one really weighs the matter carefully, decidedly cheap and inadequate lighting equipment. This state of affairs should not continue. It is all very well to have the very best fixtures in the showy parts of the building if there is plenty of money to be spent, but where the appropriation is limited, those having the matter in charge should make sure that the classrooms where the work is actually done are taken care of first.



TYPICAL CLASSROOM, ILLUSTRATING DESIRABLE ARRANGEMENT OF OUTLETS FOR DIRECT-LIGHTING LUMINAIRES

Using enclosed diffusing globes, the following approximate values of illuminating would be obtained: With 200-watt lamps, 8 foot-candles; with 300-watt lamps, 12 foot-candles. With a semi-indirect system four outlets would be sufficient. The approximate values with 300- and 500-watt lamps would be 7 and 14 foot-candles respectively.

As pointed out above, sufficient illumination must be provided on the desks, tables, and benches. Experience has indicated that the following levels of illumination should be provided for eye conservation and comfortable working:

Ordinary classroom	8 to 12 foot-candles on desks
Laboratory	8 to 12 foot-candles on tables
Study rooms	10 to 15 foot-candles on desks
Drafting rooms	15 to 25 foot-candles on tables
*Sewing rooms	15 to 25 foot-candles

While such values as given above will produce satisfactory results, the higher, rather than the lower, levels are recommended. With the higher values of illumination an increased degree of perception is obtained, and better results may be expected. If increased production in industrial plants and offices can be profitably brought about by high-level lighting, why should not increased speed and accuracy of accomplishment on the part of the pupils likewise be worth while?

As an unfortunate result of our economic system, students are usually compelled to work under less light than is provided in industry for similar operations. In reality, more light is needed, because the pupil in the process of learning has to give closer visual attention than a workman, to whom a process becomes more or less automatic.

Modern methods of illumination distribute the light uniformly throughout the room, and the old system of having drop-lamps close to the work is of course entirely superseded by general illumination from lighting units hung high without being in the line of view, if possible.

The harmful effects of glare cannot be overemphasized. Anyone who has happened to glance, even for an instant, into the extreme brightness of the noonday sun will realize the extreme strain and eye fatigue incident to such a procedure. With the development of more efficient lamps with their increased intrinsic brilliancy, the likelihood of harmful glare from artificial light sources is becoming greater. Practically all commercial light sources are far too brilliant to be in the field of view without producing a blinding effect and reducing the ability to see. We must therefore always reduce the brilliancy of the light by means of diffusing globes, shades, or reflectors, which either effectively enlarge the light sources

* *Note:* Even though adequate light can be supplied for any process, it is inadvisable to permit young children to do fine needlework and the like under artificial illumination. The periods should be so planned that this work may be done when there is plenty of daylight.

NIGHT VIEW OF CLASSROOM, WEST SIDE HIGH SCHOOL, NEWARK, N. J.

The room, 21 by 49 ft., with 13-ft. ceiling, is lighted by eight 200-watt Mazda lamps in squat type, diffusing globes, on 12-ft. spacings and 9-ft. height. Average illumination 9 foot-candles.

or actually hide them from view. Diffusion also softens the shadows, so that severe contrasts are less likely to occur.

Not only must light sources with proper diffusing qualities be installed, but the walls and other objects also must be given attention. Dull, rather than polished, surfaces are desirable, and even a de-polished or wax finish is more desirable than varnished or highly polished surfaces on the desks and other furniture, as the latter produce mirror-like effects, in reflecting the light sources. In this connection, attention should also be given to the desirability of matt rather than glossy finished paper, for paper with a glossy finish likewise reflects light in an annoying manner.

It is always desirable to shield or diffuse the light at angles near the horizontal and to provide as even an illumination throughout the room as is possible. Although a certain variation is permissible, the ratio of the maximum to the minimum level of artificial illumination, measured in foot-candles at the desk tops, should always be less than 2 to 1. A symmetrical spacing of outlets is therefore essential.

It is always desirable to hang units as high as possible in order to keep them out of the field of view. No lighting units should come below a line extended from the eye of a student in the rear seat to a point 2 feet above the blackboard. In no case should the lamp itself be easily visible.

The fixture in the ordinary classroom serves a purely utilitarian purpose—that of supporting the glassware and lamp. It should therefore be simple in character; the means of suspension of any type of lighting unit should be such that there is absolutely no danger of glassware falling, and especially in the case of indirect units, it is desirable to have some convenient means of cleaning.

The wiring should be so arranged that the switches are readily accessible. It is often advisable to have one circuit controlling the lamps near the teacher's desk, so that he or she may work after hours without having the whole room lighted; the remaining lights should be on a separate circuit.

There is a likelihood of glaring reflections from blackboards, and they should, therefore, always have matt, rather than polished, surfaces. It is sometimes possible to eliminate reflection by tilting the board slightly. Blackboards which will be written on with colored chalk and those that are more than 20 feet away from the pupil should be specially lighted to a level approximately 60 per cent higher than the rest of the room. This can be accomplished by the use of properly screened and judiciously placed local units, similar to the systems commonly used on outdoor signs, etc. Blackboards should never be located between

windows, since the contrast between the black surface of the board and the bright sky will be too great for eye comfort.

Selection of Lighting Equipment

Direct, semi-indirect, and totally indirect systems are all employed for school lighting. There are a number of factors which must be taken into consideration in the selection of lighting equipment. These are briefly stated below:

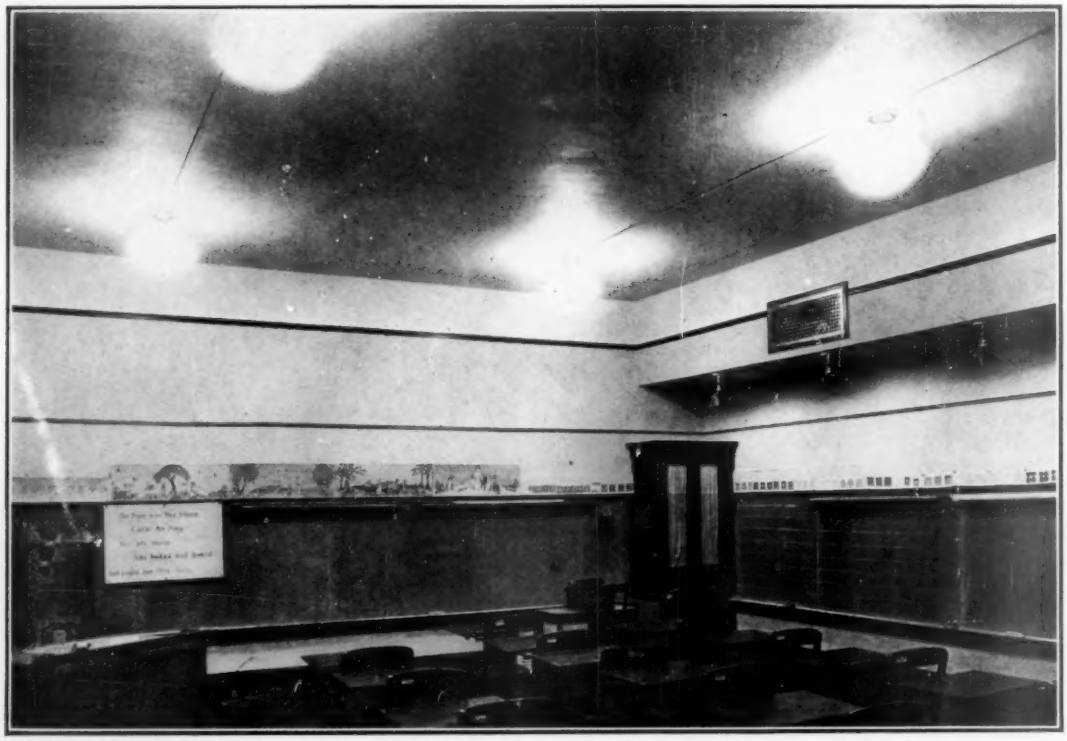
Quality of illumination produced
Convenience of maintenance
Appearance of the installation
Efficiency of the system
Ability to produce the desired illumination
Cost of installation

Obviously, the type of lighting equipment to select is that which will give a desirable quality of illumination in as efficient manner as possible over a long period of time. The general appearance of the unit is important, but this is largely a matter of personal opinion and is impossible to evaluate. Any decoration of luminaries should be very simple, for appearance of excessive ornateness is out of keeping with the character of the schoolroom. Deep crevices in glassware, although they might be considered attractive, are objectionable from the standpoint of dust accumulation.

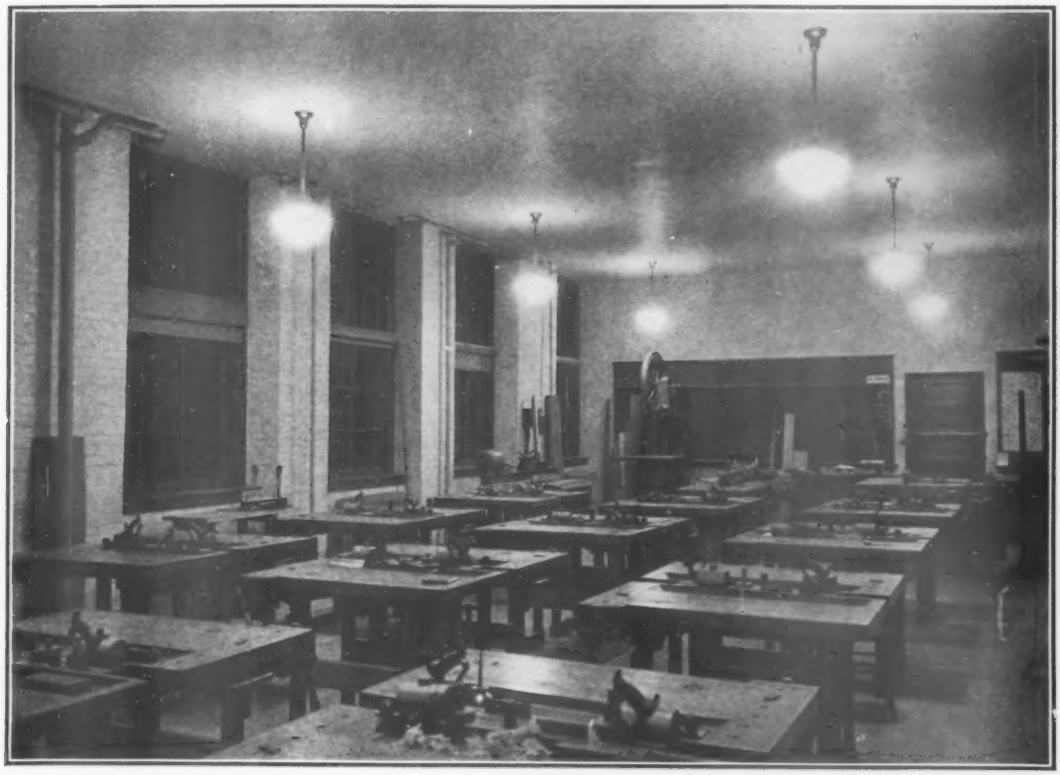
Whatever lighting system is installed must be cleaned regularly. The lighting in all schools would be far better if it were properly maintained. Unfortunately, supervision is usually meager and the periods between cleanings are of considerable length. Much light is lost because lamps and reflectors are covered with dirt and dust. Burned-out and blackened lamps should be promptly replaced. Observation of many installations indicates that so little dependence can be put on the matter of satisfactory maintenance, that the lighting engineer hesitates to recommend systems which are inherently better than others.

Totally indirect systems produce a very good quality of illumination, but require a relatively high wattage for a given level. With such a system there is little possibility of glare, and the light is soft and comfortable; glaring reflections are at a minimum, contrasts are reduced, and shadows are softened. The inverted bowls, however, tend to accumulate considerable dirt, and unless they are frequently cleaned, the light output is materially reduced. A well-supervised system of maintenance is absolutely essential where totally indirect lighting is installed.

Semi-indirect lighting is an intermediate step between the direct and totally indirect systems. Luminaires employed in this type of lighting direct most of the light toward the ceiling, while a relatively small portion is transmitted downward through the glassware. Such a system is slightly more efficient than totally indirect lighting; the resultant illumination is well diffused, and such shadows as are produced are soft and cause



SPECIAL LIGHTING FOR BENEFIT OF CHILDREN WITH DEFECTIVE VISION, 18TH AVENUE SCHOOL, NEWARK
The room is 24 by 32 ft. with 12-ft. ceiling. Six 300-watt lamps in color-modifying globes, on ceiling; side blackboards lighted by six 25-watt lamps. Average illumination at desk level, 15-foot-candles.



NIGHT ILLUMINATION OF MANUAL TRAINING ROOM, WEST SIDE HIGH SCHOOL, NEWARK
200-watt Mazda lamps in opal enclosing globes.

no annoyance. The best forms of semi-indirect units employ dense glass or some other means of reducing the brightness of the lighting unit. This type of lighting is particularly well adapted to schoolrooms, especially so if the totally enclosing type of semi-indirect luminaires, of which the upper portion is of clear glass, is used. An open type, semi-indirect unit is subject to the same objections as are applied to the totally indirect luminaires, in regard to accumulation of foreign materials, and consequent reduction of light output.

The enclosing, diffusing, direct lighting luminaire seems to be, at the present stage of the art, the equipment most generally applicable for classroom lighting, if careful maintenance cannot be assured. If the proper type is chosen, a well-diffused illumination, relatively free from direct or reflected glare, is produced. Although the major portion of the light is directed downward, a considerable amount is transmitted upward, thus giving a cheerful appearance to the room and a character of illumination quite similar to that produced by semi-indirect units. Such equipment is easily cleaned, and, in general, does not depreciate as rapidly from the accumulation of dirt as do other fixtures providing the same quality of illumination. This should not be taken to mean that cleaning can be neglected, for it is always of primary importance.

The question has often been raised, whether it is necessary to provide ventilation for a totally enclosing unit. Carefully conducted tests have indicated that with sufficient radiating surface—in other words, an adequate size of globe and fixture—ventilation is unnecessary when Mazda C lamps are used. Practically all types of fixtures of this nature on the market are sufficiently large to provide the necessary radiation. From a maintenance standpoint, ventilation is undesirable, for with it a current of air passes through the fixture, and dust is naturally deposited on the glassware and lamp. With a fixture tightly closed, this action is negligible.

A number of factors must be taken into consideration when making a choice between commercial types of equipment of any one class. Of the equipment under consideration, that is, the enclosing diffusing unit, one important element is the intrinsic brilliancy of the glassware. This is dependent on the character of diffusion produced, the size of globe or glassware, and the wattage of the lamp used.

If the diffusion is inadequate, as, for example, that produced by a sand-blast clear glass globe, there will be a bright spot opposite the lamp, while the rest of the globe will be considerably less brilliant. The bright spot is the determin-

ing element. Assuming, however, that the globe gives good diffusion, the brightness will then depend on the diameter of globe and the size of the lamp used. A given globe might be entirely satisfactory with a 100-watt lamp, but very unsatisfactory with a 300-watt lamp. For the position, and the height ordinarily encountered in classroom lighting, a maximum brightness of three candles per square inch should not be exceeded.

The following table indicates the minimum desired diameter of enclosing globes, the diameter to be measured at the maximum width:

With 100-watt Mazda lamps	12 in.
With 150- " " "	14 in.
With 200- " " "	16 in.
With 300-500-watt Mazda lamps	18 in.

Some of the forms of fixtures under consideration have a portion of the globe of clear glass, and it is well that such equipment be examined for the possibility of filament reflections or images in the unit itself. With a globe of uniform character, such as opal glass, these do not occur. So called semi-enclosing units must be very carefully designed to avoid these images.

There is comparatively little choice between the various fixtures of the type under consideration as to their efficiency with light-colored surroundings. If the ceiling is dark, it is apparent that any type which emits considerable light upward will not be as efficient as the semi-enclosing units or those provided with some sort of reflector which has the property of directing the major portion of light into the lower hemisphere.

The shape of the uniform diffusing globe is, however, very important. The squat, or flat, type is more efficient than the spherical, or stalactite, shape in directing the light downward and emitting less toward the upper part of the side walls, where it is of comparatively little service.

Light on the ceiling is not at all objectionable; in fact, it is desirable, as when reflected downward it reduces contrasts and softens shadows. Therefore, it is generally advisable to paint the ceiling a light tint, regardless of the type of lighting installed.

A typical specification for a school lighting unit of the diffusing enclosing type might be drawn up as follows:

The glassware should be of thin, blown, opal or cased glass, giving diffusion of the same order as that produced by [insert trade name of suitable diffusing glass].

It shall be of such a size that the brightness with recommended size of lamp, is not over [insert the desirable candles per square inch].

The light output of a complete unit with holder shall be better than [insert per cent of clear bare lamp output desired].

It shall be of such a shape that the horizontal section is greater than the vertical section.

The supporting holder shall be sufficiently strong and of such a type as to preclude any possibility of the glassware falling.

The method of support shall be such that the globes can be readily removed for cleaning.

Similar specifications can be readily drafted for other forms of equipment.

CHEMISTRY LABORATORY, WEST SIDE HIGH SCHOOL, NEWARK, LIGHTED BY 200-WATT LAMPS, 12-FT. CENTERS

A uniform illumination of 8 foot-candles is obtained on the table tops.

Structural Design of Floors and Walls

BY REGINALD E. MARSH

OF TOOKER AND MARSH, ARCHITECTS, NEW YORK

ONE of the most important factors in the planning of any building, and particularly educational buildings where hundreds of young children are gathered together, is that of construction. This subject covers so many technical details that the layman is inclined to rely on the judgment of others. It will be the purpose of this article to explain briefly and non-technically a few of the more important types of wall and floor construction.

The cost of a building depends to a great extent on the type of construction used. Economy is too often considered of primary importance, to the detriment of the building itself. Very often, also, the architect is forced to sacrifice first-class construction because the requirements for space given to him by the owner are absolute and the cost is limited.

That this is not real economy has been forcefully brought to the attention of the public through recent publicity given to the trouble with leaky walls. During the past few years there has been a serious indifference on the part of many mechanics in the execution of their work, with consequent unfortunate results. It is therefore of primary importance to make wall and floor construction not only adequate but as foolproof as physically possible, even though the cost is thereby increased.

Bearing Wall Construction

Wall construction may be divided into two major divisions, namely, bearing wall construction, and skeleton construction. Brick and tile will be taken as the two materials for discussion for bearing walls, and steel and reinforced concrete will be used as examples of skeleton construction.

Solid wall construction means a wall constructed of all brick laid in portland cement mortar.

Veneer construction covers a wall with 4-inch or 8-inch brick facing, with hollow tile, cinder or cement block backing.

As far as load-bearing qualities are concerned, either solid or veneer construction is satisfactory, with certain provisos which apply to the veneer type.

In veneer construction careful selection should be made of the materials to be used for backing. Only heavy load-bearing type should be considered for terra cotta tile. Cement or cinder block should be used only when manufactured by reliable concerns operating under recognized established systems.

It is considered good practice in veneer construction to make all piers and points of concentrated loads of solid brick. This includes window and door jambs. Tile is sometimes used filled with concrete, but such construction cannot be considered foolproof, as extreme care must be exercised in pouring the voids with the cement mortar to make sure that the mortar reaches the bottom and fills the voids completely.

The tile may be laid with the webs laid vertically. The advantages claimed for this type are strength and no horizontal beds for the water to seep through. There is, however, the difficulty of laying the tile with continuous webs and also the comparatively small area for the mortar bed.

An interlocking tile may be used with webs horizontal. A header backer tile is also laid with horizontal webs. The main difference between these two methods lies in the breaking of all horizontal joints between the brick and tile, which the writer believes to be advantageous. In all cases, the face brick should be bonded into the tile every sixth course with a full header course.

Skeleton Construction

The term "skeleton construction" refers to a series of columns and girders supporting the floor construction with the walls built in between with solid brick, brick veneer, or tile and stucco. This construction is rarely used in a two- or even a three-story building.

It is the writer's opinion that there is no economy or advantage to be gained in skeleton construction until the height is so increased as to require excessive thickness of masonry bearing walls. Skeleton construction requires skilled contractors specializing in this class of work. In educational work, the practice of public bidding is generally followed, and consequently the most economical results consistent with good construction can be obtained by adhering to bearing wall construction.

Stucco is an exterior cement plaster applied on brick or most frequently on tile. Stucco, however, is a material which requires skillful handling and application to obtain permanent results, and consequently is not generally used.

However, regardless of type, whether solid brick, brick veneer or skeleton, unless the face brick is laid with all joints (and particularly the vertical joints) slushed full and all possibility of open joints eliminated, there is bound to be seepage of water regardless of kind of mortar used. For this reason the struck or ruled joint (preferably the latter) should be used. With a ruled joint, a rounded tool is used and the mortar is pressed into the joint and against the brick. With a rough cut flush or raked-out joint, it is obvious that there is a tendency to tear the mortar away from the brick, particularly as it is impossible to finish the joint until the mortar has slightly stiffened or set.

Making Walls Waterproof

There is a great difference of opinion regarding the kind of mortar to be used. In certain localities, portland cement mortar with only a small percentage of lime is required by the local building code. As lime is recognized as one of the best waterproofing materials, this omission has been offset by the use of waterproofing ingredients, of which there are many on the market but only a few which can be considered reliable.

A mixture of equal parts of portland cement and lime with three parts of clean, sharp sand makes a very waterproof mortar, as well as an extremely strong wall.

After the walls are built, an added protection should be given by the use of a coating of an asphalt or similar dampproofing compound. Before this application is made, all joints on the interior should be carefully inspected and pointed up.

This dampproofing may be applied with a gun, brush or trowel. The gun-applied dampproofing is shot on under pressure, the material being thin enough to allow for this treatment. The brush-applied dampproofing is of a thick consistency, while the troweled material is heavy, applied a full ⅛-inch thick, with a thin coating added just before the plastering is started, to fill any possible pinholes.

Plaster may be applied direct to this dampproofing, or furring may be used. The furring is often omitted because of the additional cost, and a substantial job can be obtained without the furring, providing the other requirements are properly taken care of. Furring will not prevent leaky walls, but it does overcome to a great extent unsightly walls where leaks occur. In the writer's opinion, the use of furring for this purpose is objectionable. Leaky walls should be eliminated and any leaks should be discovered and remedied. Furring, however, does make a warmer wall and thereby conserves coal or oil consumption.

Furring may be wood strips, split tile or self-furring lath. Split tile is the best material, but also the most expensive.

One of the most troublesome points in a building is at the window heads and sills. All window and door frames should be calked at jambs and heads with oakum or mastic tightly driven into the space between the wood and masonry, to overcome shrinkage of the wood frames.

A lead water-bar let into the masonry and wood sill and calked with an elastic compound will solve the sill problem.

At the heads, a spandrel waterproofing can be used. This consists of a layer or layers of felt laid over the steel or concrete lintel extending up above the floor level and out under the brick or stone lintel. This will prevent any water which may seep through from coming through the window or door heads.

In addition, a similar construction may be used at the floor levels extending continuously around the entire building.

Parapet walls are a constant source of trouble unless properly constructed. The possibility of soft salmon brick should preclude the use of common brick for the facing of parapet walls which are exposed on both sides to the weather. No parapet wall should be built less than 12 inches thick. A good face brick should be used on both sides. A copper or felt flashing (preferably the copper) should extend through the wall over a brick curb to provide a bond to within 1 inch of the outside face of the wall. This flashing should be continuous and lapped down over the metal or felt flashing of the roof itself.

If the above suggestions are followed, the wall may be considered tight and not expensive, considering the possibility of using hollow tile for wall backing.

Floor Construction

Floor construction may be divided into three divisions, namely, non-fireproof, semi-fireproof, and fireproof.

Non-fireproof floors are constructed of wood.

Semi-fireproof floors may be built with metal lumber, pressed steel, open bar joist or similar type. These floors are considered fireproof by some authorities, inasmuch as they will not burn and are protected on top with metal lath and concrete and on the soffit with metal lath and plaster. In some building codes they are classed as non-fireproof, as they are subject to twisting or bending under high temperatures such as generated by a serious fire. However, when manufactured by reliable concerns, they may be considered foolproof. By using a spandrel dampproofing similar to that already mentioned, all possibility of dampness corroding the steel is obviated.

Fireproof floors are constructed of reinforced concrete, either steel or concrete beam and concrete slab, tile filler and concrete, or metal forms and concrete. This material will not burn. The most serious objection is that it is not foolproof, requiring a reliable and experienced superintendent to make certain that the correct steel reinforcement is used, properly spaced, and the concrete properly mixed.

State and Local Building Codes

The safeguarding of the lives of children cannot be given too much attention. State laws covering the planning of school buildings vary greatly throughout the United States. Certain requirements for lighting, ventilation, floor area and cubical contents of classrooms have been more or less adopted as standard practice. Fireproof stairs and corridors are almost universally required.

A more rigid building code covering floor and wall construction would materially help in obtaining more substantial and permanent school buildings. A little more money spent on these two items can be more than offset by simplification of finish both inside and outside.

It would appear that there is a big opportunity for improvement along these lines.

Current School Ventilation Practices in Typical American Cities

BY THOMAS J. DUFFIELD

EXECUTIVE SECRETARY AND DIRECTOR OF FIELD STUDIES, NEW YORK COMMISSION ON VENTILATION

SCHOOL ventilation, or, as it should more properly be called, air conditioning, is one of the most perplexing problems with which boards of education throughout the greater part of this country have to contend. To appreciate the fact that there is no general agreement as to the most satisfactory method of school heating and ventilating, one need but read the following description of the ways in which school authorities in typical American cities are attempting to solve the problem.

In each of these cities practice differs in one or more essentials. Four of the six now employ complete mechanical systems, with fan supply and fan exhaust; one supplies outdoor air through the unit system of heating and ventilation and provides central fan exhaust; one provides a natural supply through the windows and supplements this with fan exhaust. Three of the cities use the all-blast system, in which all heat is supplied by the incoming air; two have all the heat supplied by direct radiators in the classrooms; one operates on the split system, which provides heat through a combination of direct and indirect radiation.

One city recirculates all the air it possibly can (except that exhausted from laboratories, shops, kitchens and toilet rooms), renewing with outdoor air only that which is lost by leakage, and it treats the recirculated air with ozone to minimize the effects of odors that would otherwise accumulate. Others recirculate to a slight degree, without resort to ozonation. Two do not recirculate any of the air, exhausts from the classroom discharging directly out of doors.

Choice of the type of ventilation must depend upon detailed analysis of the problem to be met, and it is probable that as the question is studied more intensively, there will evolve a system more generally satisfactory than any described in this article.

FIG. 1. A TYPICAL INSTALLATION IN A NEW YORF CITY CLASSROOM

New York City

Since May, 1923, when the Board of Education of New York City adopted the unit system as the standard type of heating and ventilation for all new elementary schools, over 100 school buildings in which this system has been installed, have been constructed. Figure 1 shows a typical installation.

The essentials of the unit system as employed in the recently constructed New York City schools are as follows: Each classroom has:

1. At least one heating and ventilating unit with window inlet for admission of outdoor air;
2. One or more direct radiators to compensate for structural heat losses during extremely cold weather;
3. Thermostatic control of the mixing dampers in the unit and of the supply of steam to the direct radiators;
4. Mechanical exhaust of the air from the classroom through the clothes closet, by means of a central fan exhaust system.

Each heating and ventilating unit of the type used in schoolrooms is enclosed in a metal cabinet from 12 to 16 inches deep, from 3 to 4 feet high, according to the location of the inlet, and from 2 to 4 feet long, according to the size of the radiator used.

Units (see Fig. 2) comprise the following parts:

1. Air inlets from outside and for recirculation
2. Electric motor and fan
3. Heating element (steam or hot water radiator)
4. Cold air by-pass
5. Mixing chamber
6. Air discharge outlet into room
7. Recirculating control damper
8. Temperature control damper
9. Water pan for humidification
10. Air filters

One or both of items 9 and 10 are omitted from some makes now on the market.

The operation of such a system proceeds as follows: To heat the school in the morning before the pupils arrive, the boilers are fired and the units are run with the recirculation dampers open and the inlets for the admission of outdoor air closed. Heat is supplied by both the radiator in the unit and the additional direct radiator in the room. The operation of the unit fan at this time speeds up the heating of the room by bringing quantities of cool air in contact with its radiator, thus promoting the condensation of the steam. At the same time it tends to distribute the heat in the room evenly, both vertically and horizontally.

When the temperature throughout the building approaches the desired point, the air-compressor of the thermostatic system is started, and (if everything functions properly) this regulates the by-pass dampers of the unit and the steam supply to the direct radiators in accordance with the temperature needs of each room. Just before the pupils arrive, the window inlets are opened and

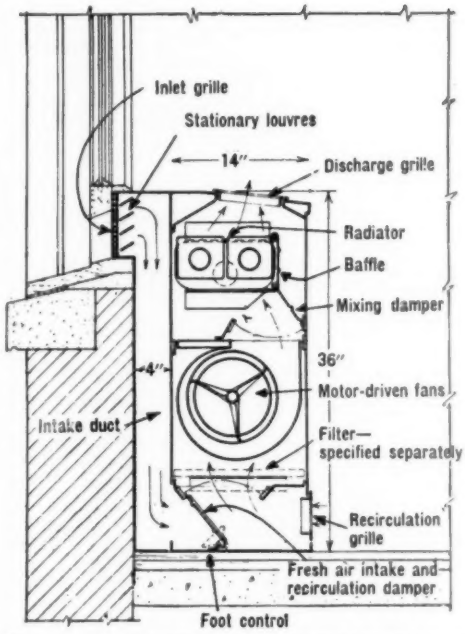


FIG. 2. CONSTRUCTION OF VENTILATING UNIT

the recirculation dampers closed. At the same time, the central exhaust fan is started, and the system is run in this manner until the school day is over. With the unit fan running and the inlet damper open, air is drawn directly from out-of-doors. It is then forced into the room after having passed over the radiator to be heated, by-passed through the cold air chamber, or partly heated and partly by-passed. The temperature control dampers of the unit and the admission of steam to the supplementary direct radiator function under thermostatic control.

The reasons given by the architect in formulating the recommendation in favor of the change from the central supply split system previously in use, will doubtless be of interest to all persons dealing with problems of school ventilation. They were:

1. To reduce installation costs
   a. "The installation of the unit system will effect a saving of from 5 per cent to 10 per cent [presumably in the cost of equipment—T. J. D.] . . . per building, depending on size and type."
   b. "The unit system would obviate larger apparatus rooms, underground ducts and deep basements, thus effecting a saving of not less than 8 per cent. . . ."
2. To reduce operating expense
   a. "By eliminating the expense of ventilating unoccupied rooms."
   b. "By eliminating losses due to duct resistence, the motor horsepower per volume of air discharged, is decreased."

3. "To eliminate larger and expensive apparatus which at times is idle."
4. "To reduce fire and panic risks by the elimination of ducts from the basement."
5. "To permit independent operation
   a. "Rooms need not be ventilated when unoccupied; thus each room becomes an individual system."
   b. "Rooms for 'after hour' use may be ventilated separately."
6. "To facilitate heating
   a. "Unit heaters allow for quick heating by recirculation."
   b. "By closing the outdoor damper and opening recirculating damper, units become direct radiators for night use."
   c. "Direct radiators in the same rooms become operative only in extremely cold weather."

The reasons given are entirely economic and practical, and there are, doubtless, engineers and architects who would not agree on all of these points. No reference is made to the relative effects of the different systems of ventilation on the health of the pupils. If any consideration was given to this phase of the subject, no mention is made of the fact.

Chicago

As a result of the opinion that rooms are more certain to be ventilated when the heating depends upon the air supply, Chicago practice in public school heating and ventilation prescribes a plenum, all-blast system, with direct radiation only in offices, corridors and other special rooms.

For some years past, public schools in Chicago have been built three stories high, without basements. Beneath the main corridor of the first floor, a plenum chamber about 7 feet high and 14 feet wide extends the entire length of the building. (See Fig. 3.)

In general, the heating and ventilating equipment is divided into three units, one for the assembly hall and one each for the classrooms in the two halves of the building.

Outdoor air is drawn into the system through a central shaft opening above the roof, is passed over (indirect) steam radiators (see Fig. 4) or by-passed around them, according to the outdoor temperature, and, where necessitated by the dustiness of the atmosphere, through an air washer, being finally delivered into the plenum corridor at a temperature of 65° F. and with a relative humidity of 40 per cent.

Where air washers have not been installed, this humidification is accomplished by means of steam jet humidifiers which are automatically controlled from typical rooms. In all recent construction, however, space has been provided for air washers, should their installation become necessary by reason of industrial development in the community.

From the plenum corridor, vertical supply ducts deliver the conditioned air to the classrooms. In order to supply the additional heat necessary during extremely cold weather, additional banks of indirect radiators under manual control are located at the base of each of these vertical stacks. Mixing

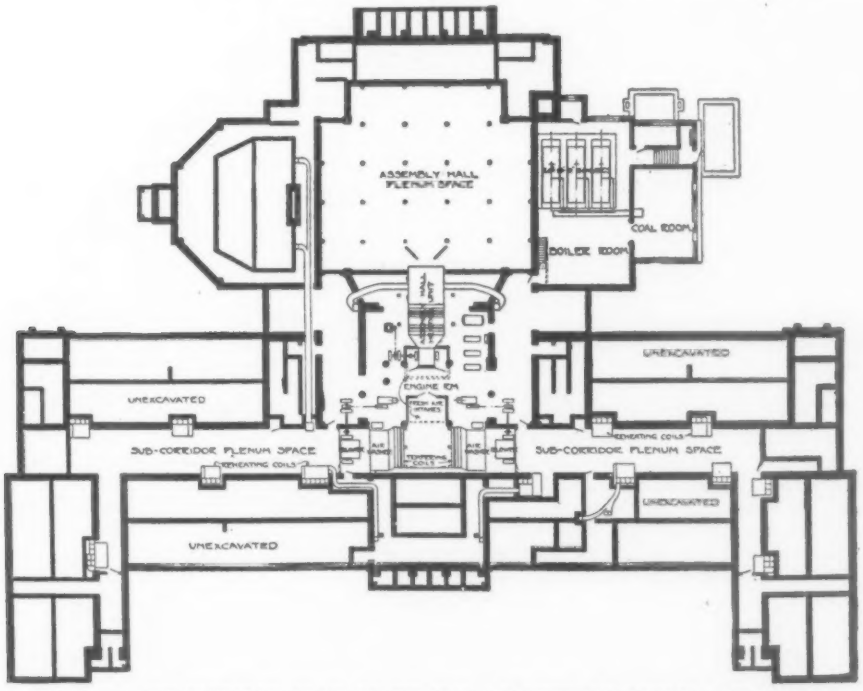


FIG. 3. SUB-CORRIDOR PLAN OF TYPICAL ELEMENTARY SCHOOL—CHICAGO

dampers, under thermostatic control from the classroom, determine the relative quantities of heated and tempered air admitted to keep the temperature between 67° and 70° F.

The point of admission of the air is at the rear of the room in the corridor wall about 8½ feet above the floor (see Fig. 5). This location was selected because, under ordinary conditions, the air passes across the room toward the outside walls and windows, where being cooled,

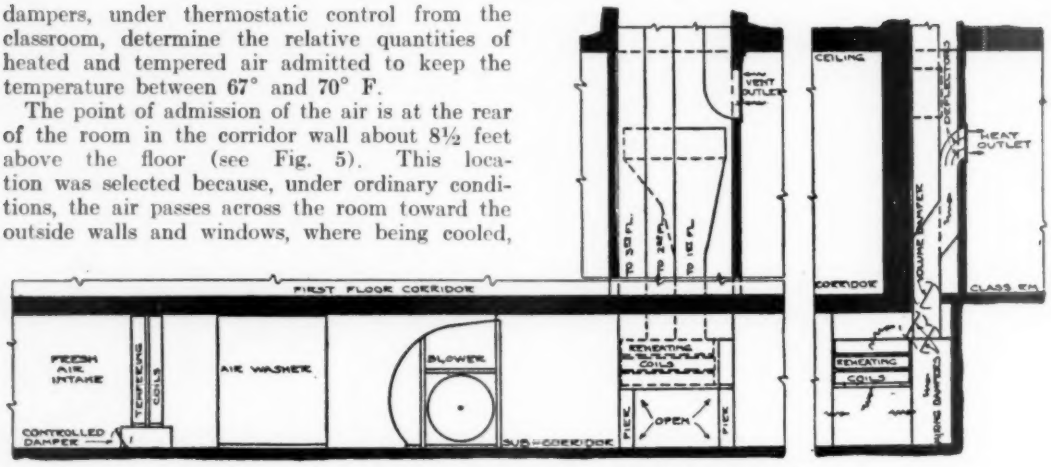


FIG. 4. TYPICAL SECTIONS THROUGH CORRIDORS—CHICAGO

it falls toward the floor, from which it is withdrawn through vent openings beneath the doors of the clothes closet, which line the corridor wall.

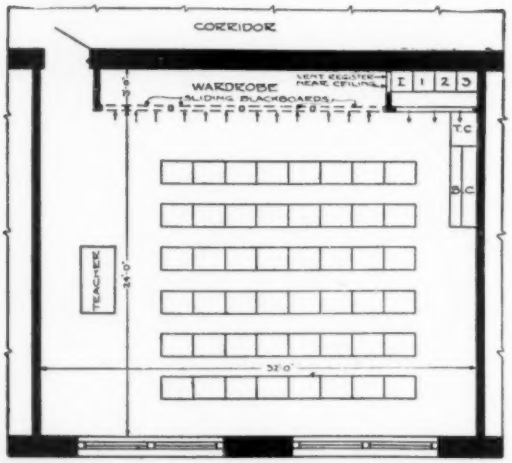


FIG. 5. PLAN OF TYPICAL CLASSROOM—CHICAGO

From this clothes closet, an exhaust duct, opening near the ceiling, withdraws the air from the classroom after it has passed through the pupils' wraps and discharges it in the attic space from which it is removed by the main ventilators.

Until recently, recirculation of air has been limited to that from assembly rooms only, but the question of recirculating air from classrooms has been considered by the Committee on Health and Sanitation of the Chicago Board of Education. The reduction in costs of both installation and operation make recirculation desirable if it can be accomplished without adversely affecting the health of the pupils.

Rooms that may be expected to be used after regular school hours when the fans are shut down, and rooms with unusual exposure, are provided with direct radiation.

Collaboration of the engineering and architectural staffs in the design and installation of heating and ventilating equipment has resulted in designs that are considered economical and practical, because the plants are operated under the same authority that draws the plans and makes the installations.

Detroit

The heating and ventilation of the classrooms in the more recently constructed public schools of Detroit are accomplished by means of a rather ingenious variation of the all-blast system.

Under the usual method of employing this system, heated air, introduced into the classroom through duct openings near the ceiling of the corridor wall, flows across the room and, during periods of low temperatures out of doors, it is chilled by contact with the cold outer walls and windows. As a result of the change in density due to this chilling, the air falls toward the floor near the outside wall, with the result that the pupils in the outer row of desks are in an atmosphere frequently 5° F. and sometimes 10 or more degrees lower than those seated at desks on the inside aisle.

To overcome this objection, the Detroit system (see Fig. 6) instead of admitting the entire supply of heated air through the duct openings on the inner wall of the classroom, puts in only about 80 per cent of the supply in that manner. The remaining 20 per cent is introduced through narrow slits (from 1/16- to ¼-inch in width) extending the whole length of the window sills (see Fig. 7).

The film of warm air rising from his slit mixes with the descending chilled air and flows back across the classroom at the temperature level of the mixture. This is said to have corrected entirely the uneven horizontal temperature distribution which existed before.

Aside from this rather unique method of introducing a portion of the heated air through the

window sills, the Detroit system operates much the same as any all-blast system, in which the air for ventilation serves as the carrier of the heat to compensate for structural losses. Recirculation is used to a greater or less degree, thus conserving heat and lowering operating expense. Apparatuses for air cleaning, humidification and automatic temperature regulation are installed and operated.

Instead, however, of employing a single plenum supply chamber, a double chamber is used, as entire length of the building beneath the first floor, and the cooler air into the other half.

Mixing dampers, under the thermostatic control from each room, regulate the relative quantities of heated and tempered air from this main supply duct entering the branch ducts leading to the room and thus maintain the desired temperature. The branch ducts—of which there are two for each standard classroom—are again divided to provide for the admission of 80 per cent of the air to the room through the opening near the ceiling of the

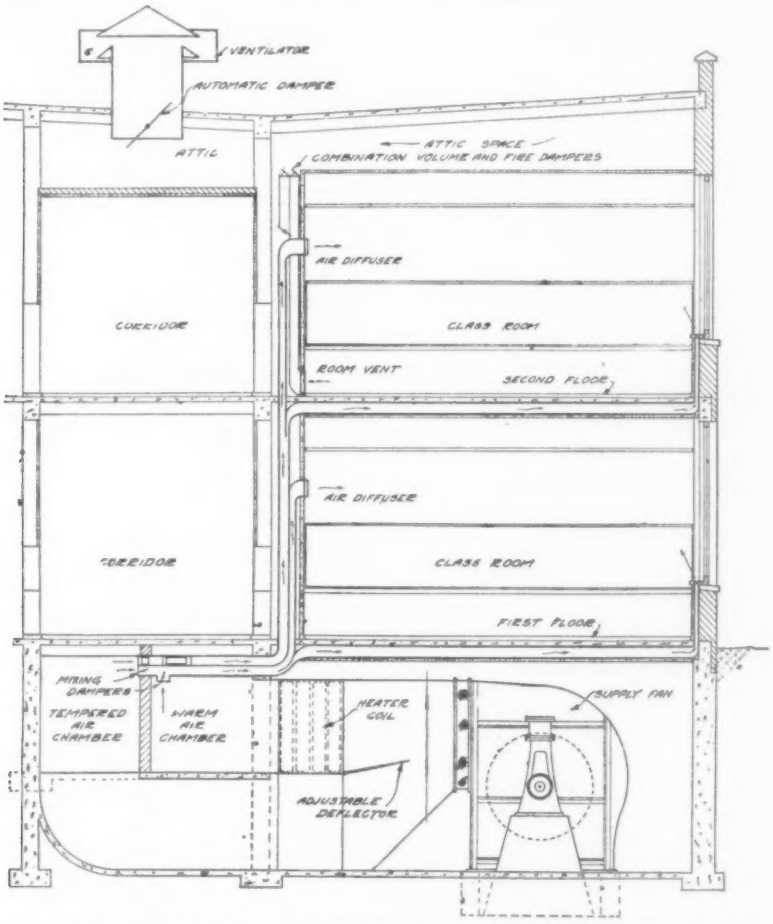


FIG. 6. THE VENTILATING SYSTEM OF THE DETROIT PUBLIC SCHOOLS

shown in Fig. 6. Outdoor air is drawn into the system through a shaft which opens above the roof, but which is also connected with the attic, where the ducts from all the classrooms terminate, making possible, by regulation of the supply and exhaust dampers, recirculation of any desired portion of the air.

After passing through the apparatus for cleansing and humidifying the air, a portion of it is passed over (indirect) radiators and heated, while another portion is by-passed around the heating coils. The heated air is delivered into one half of the double plenum corridor, which extends the corridor wall, and 20 per cent through the window slots, as described above.

This variation of the all-blast system overcomes an objection that has frequently been raised against the conventional systems of this type, in that it introduces heat at a point where needed to compensate for losses through and around the windows. In this, it approaches the results obtained by the split system, in which steam radiators, located beneath the windows, supply the heat lost in this manner. Construction costs, however, are said to be less than with the split system. On the other hand, it being necessary to

run the fans whenever heat is desired, operation costs are probably higher.

Cleveland

In Cleveland, the current practice of heating and ventilation in public schools is to install the conventional split system. In this method, part of the heat required is supplied by direct radiators located in the classrooms, and part is carried by the air provided for ventilation.

Outdoor air is drawn into the system through a large stack opening above the roof of the building. In the basement the air passes over preheating coils and then through an air washer for removing the dust. At the same time, through adjustment of the temperature of the water and of the air, both before and after washing, the humidity is automatically regulated. Air, thus cleansed and humidified, is drawn through the supply fans, reheated by passing over indirect steam radiators, and delivered at a temperature of approximately 78° F. into the supply tunnel, which extends the length of the building below the main corridor of the first floor.

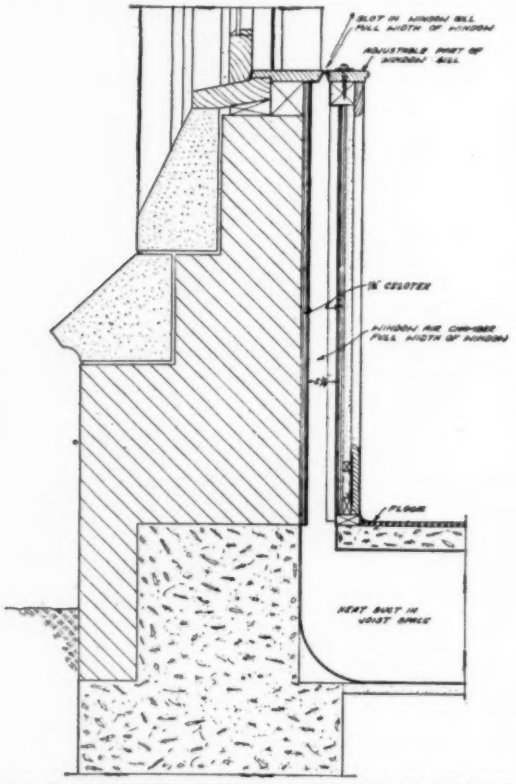

SLOT IN WINDOW SILL FULL WIDTH OF WINDOW
ADJUSTABLE PART OF WINDOW SILL
1/4" CELOTEX
WINDOW AIR CHAMBER FULL WIDTH OF WINDOW
FLOOR
HEAT DUCT IN JOIST SPACE

FIG. 7. SHOWING ADMISSION OF PART OF HEATED AIR THROUGH SLITS IN WINDOW SILLS (DETROIT SYSTEM)

From this tunnel vertical ducts deliver the air to the classrooms through openings in the corridor wall approximately 8½ feet above the floor. Being blown across the room by the pressure supplied by the fans, this air is cooled by contact with the outside walls and windows and tends to fall toward the floor. If the outdoor temperature is so low that the air when it meets the outside wall and windows is so chilled as to bring the entire volume of air to a point below that set for the room temperature, steam is supplied to the direct radiators located beneath the windows, through the action of the room thermostat. Heat from these radiators sets up a rising film of warm air to counteract the downward tendency caused by the increase in density due to cooling. The two opposing currents meet and mix, to diffuse at the temperature level of the mixture. Direct radiators in classrooms are provided with insulated metal shields to protect the pupils in adjacent seats from gross overheating.

Ducts from vent openings at the floor level lead to exhaust fan chambers on the roof of the building. These chambers are so arranged that any portion of the air may be recirculated, should that practice be adopted.

The claim has been made that although initial costs may be greater by reason of the direct radiators in the classrooms, the additional space required by those radiators and the steam supply and return mains, operating costs of the split system are actually less than in the all-blast system, where the supply of heat is entirely dependent upon the operation of the fans. This is attributed to the fact that, whereas the air in the room with an all-blast system cools down immediately when the fans are shut down, with the split system, the direct radiators keep the walls and furniture warm and the fans need be operated only when occupancy of the room requires air change.

St. Louis

The outstanding feature of the heating and ventilation of the public schools of St. Louis is, perhaps, the extremely low costs both of installation and of operation that have been reported. Hardly less interesting is the manner in which this saving over the earlier expenditure (for what is claimed to have been an inferior result) has been accomplished.

The three factors on which success has been built are:

1. The all-blast system of heating and ventilation;
2. The recirculation of air to the highest possible degree (90 per cent claimed);
3. Ozone treatment of the recirculated air to destroy the unpleasant odors that would otherwise accumulate.

By employing the all-blast system, in which the air entering the classroom carries the heat necessary for the maintenance of comfort, the location of steam radiators in the classroom is avoided with an economy of space. At the same time, the cost of the direct radiation and of the steam supply and return mains is eliminated. Against

these economies must be weighed the cost of the additional excavation and wall thickness required to accommodate the trunk and branch supply ducts from the fans and indirect heaters to the classrooms.

But the principal avenue of economy has come from the unique method of operation of the heating and ventilating plants in the newer St. Louis schools. Through the use of ozone, it is claimed that it has been possible to destroy or otherwise minimize the effect of the body odors that would normally accumulate in air that was entirely recirculated.

With the elimination of these objectionable odors, recirculation has been practiced to the highest possible degree. The only outside air entering the system is that required to replace what is lost by leakage—and great care has been taken to reduce leakage to a minimum—and that which is exhausted from laboratories, kitchens, shops and toilet rooms. The inlet for outside air is so arranged that the incoming air passes up a brick chimney through the center of which runs the steel smokestack. Thus warmed, outdoor air enters the system in the attic, where it mixes with the air exhausted from the classrooms, and is drawn by the fan down the return duct to the basement and through the air washer or dry filter, depending on its relative humidity. At this point, ozone in concentration of 1 part to 2 million parts of air is introduced. The air is then either heated by passing over reheating-radiators and introduced into the warm air tunnel, or kept at a lower temperature, being by-passed under the reheating coils.

It is interesting to note that the thermostat controlling this by-pass damper and the supply of steam to the reheating coils is located in a room in what is usually the most exposed portion of the building. This has the effect of giving the air a slightly higher temperature than would be required in the average room when the inlet damper or diffuser of the room were wide open. But the quantity of air admitted to each room is controlled by a thermostat which opens or closes the inlet damper according to the temperature needs of that individual room.

It will be seen that with such a high degree of recirculation and the consequent removal of the necessity for continuously heating large quantities of outdoor air to temperatures that are comfortable for classrooms, it is possible to reduce the size of the heating plant very materially, and this in turn has not only reduced construction and installation costs, but has also greatly cut down fuel consumption, thus reducing operation costs, as well.

In the development of the current practice in St. Louis, two of the fetishes that have dominated the mechanical ventilation of schools since its inception have very properly been discarded. The first is that of permissible carbon dioxide concentration; the second, which grew out of the first, is the rigid practice of supplying 30 cubic feet of air per pupil per minute.

It has been shown repeatedly by reliable investigators that for the relatively brief exposures such as the pupil experiences in the classroom, carbon dioxide is harmless in concentrations up to 100 times that found in outdoor air.

From the chemical standpoint, it is the presence of oxygen in the air that is important, barring obviously the presence of a poisonous gas in harmful quantities. Engineers and physiologists are agreed that the quantity of air to be supplied depends upon its temperature, humidity and motion, and upon the age and activity of the persons for whom the air is being provided.

It is unfortunate that reliable data have not been presented to show just what effect this method of ventilation is having on the health of the pupils in the St. Louis schools. Information purporting to show that the health of the pupils has been materially improved whenever the system has been used in St. Louis, has failed to differentiate between the age, race stock and sex of the pupils. These factors are all of immense importance in a comparative study of this nature, and unless they are taken into consideration, the reported results are not convincing.

If satisfactory air conditions can be obtained and maintained at such low costs without adversely affecting the health of the pupils, it is fairly certain that the St. Louis system will become extremely popular wherever school ventilation is a problem.

Syracuse

In 1926, a group composed of the City Engineer and the architects usually associated with that official in school-building projects in Syracuse visited the Weaver High School of Hartford, Conn., and after testing its ventilation, adopted for the Syracuse schools then in project a slight —but possibly extremely important—modification of what the New York State Commission had recommended in 1923 as "the most generally promising method for the ventilation of the classrooms where local conditions permit its use." *

The essentials of the system, as it has been used in Syracuse are:

1. Heating is accomplished entirely by direct radiation in the classroom.
2. Air for ventilating purposes is admitted directly from out of doors through the windows, which are open from the bottom only.
3. To protect the pupils from drafts, the window openings are covered by window boards, or deflectors, 12 to 15 inches high, resting on the window sill and sloping inward and upward, making an angle of from 15° to 30° with the vertical.
4. Two exhaust ducts opening near the ceiling in the inside wall of the classroom and another

* Ventilation.—Report of the New York State Commission on Ventilation, published by E. P. Dutton & Co., 1923.

from the clothes closet lead to a pent-house on the roof, where a motor-driven fan maintains a positive exhaust of air from the rooms.

This system does not provide for filtering the air to remove dust, nor for artificial humidification, nor does it offer any opportunity for recirculation.

Since the adoption of this policy, six school buildings have been designed and constructed with this open-window method of ventilation. The only material difference between the system adopted in Syracuse and the Commission's recommendation is that the former has provided mechanical exhaust while the Commission found gravity exhaust to be quite satisfactory.

In this system, all the heat that is required in the classroom is supplied by direct radiators located beneath the windows through which outdoor air is admitted for ventilation. These radiators—two in number—extend the entire length of the outside wall and are under thermostatic control, with the thermostats located on the inside wall of the classroom. To protect the pupils in adjacent desks from the dangers of overheating, the radiators are covered with asbestos-lined metal shields.

Just above and at the back of the radiators, slightly below the window sill, is a 2-inch steam line, or superheater, which is always hot whenever heat is required in the building. The purpose of this superheater is to furnish at all times an upward current of warm air to mix with the air which enters the room from out of doors through the lower part of the window. This incoming air is given an upward direction when it passes over the deflectors which prevent it from blowing directly on the pupils.

As the outdoor air passes over the top of the deflector, it mixes with the rising current of warm air from the radiator (or superheater) and is thus carried toward the ceiling, from which it sinks gently to find its temperature level.

Fluctuations in air currents out of doors are reproduced to a minor extent indoors, and it is to the cooling power of an intermittent breeze that the feeling of freshness and comfort experienced in window-ventilated rooms has, in part, been attributed.

The exhaust ducts open on the inside wall of the room near the ceiling. Dampers in the exhaust register are subject to regulation from the classroom. The exhaust from the clothes closet is always open, and the pupils' wraps are being constantly aerated. Air is always being withdrawn from the room in this way, and even with the room exhaust dampers closed, there will always be a slight air change.

A feature of the more recently constructed window-ventilated schools in Syracuse is a mechanism for regulating the opening of three windows at a time. Previously, with the common type of double-hung sliding sash, it had been necessary to adjust the opening of each of the six windows individually. Frequently this meant that some windows were not opened at all and the opening of the others varied widely, resulting in uneven distribution.

Conclusion

In conclusion, it might be well to review the objectives of school "ventilation" as that term is generally used.

In the past, emphasis has been placed on air change to prevent the accumulation of carbon dioxide or of other deleterious substances in the exhaled breath, and it was with the object of minimizing such dangers that the systems of mechanical ventilation were developed and so generally installed during the past twenty-five or thirty years.

As a matter of fact, engineers and physiologists are now agreed that unless the school is located in an industrial community where dusts, fumes or poisonous gases constitute a health hazard, the problem of school ventilation consists primarily of providing a comfortable atmosphere, free from disagreeable odors, in which the body heat loss of the pupils can be effected in a normal manner, and may be reduced to the control of three factors—temperature, humidity, and air motion.

If the school is exposed to excessive dusts and poisonous fumes from neighboring manufacturing plants, the solution is not to be found in any system of school ventilation, which, at best, would be of service to only a small proportion of the community's inhabitants a few hours each day, five days a week, and only a few weeks in the year. The cure in such a case must lie in prevention at the source—a measure which will benefit every individual in the community 24 hours each day and 365 days each year.

With our present knowledge of the science of fuel combustion, there is no excuse for the smoke pall, which not only costs us as a nation millions of dollars each year in cleaning that would otherwise be unnecessary, but also denies individuals their inalienable right to enjoy their share of fresh, clean air and the beneficial effects of sunlight.

Air conditioning—the adjustment of the temperature, humidity and motion—has been placed on a scientific basis in many industries and in the modern theaters, where competition requires the management to offer every possible attraction.

The success with which such plants have been run illustrates that their operation is in no sense a practical impossibility when the need of air conditioning is appreciated. But, since it is more difficult to arrive at a dollar-and-cents appraisal of the economic loss suffered by failure to provide suitable air conditions in schools than where the spoilage of an industrial product shows immediately in the earnings of a company, and since our education laws require attendance, thus removing the competition that permits one to choose which theater he will attend, school ventilation (or air conditioning) has never received the widespread, careful attention it deserves. Here and there individuals and groups have gone more

deeply into the question than elsewhere, but in only a few instances have efforts been made to obtain the fundamental facts on which the scientific control of air conditions in schoolrooms must be based.

School ventilation should be considered first from the standpoint of health and, secondly, from that of economics. Every system of school ventilation should satisfy at least one of the following conditions:

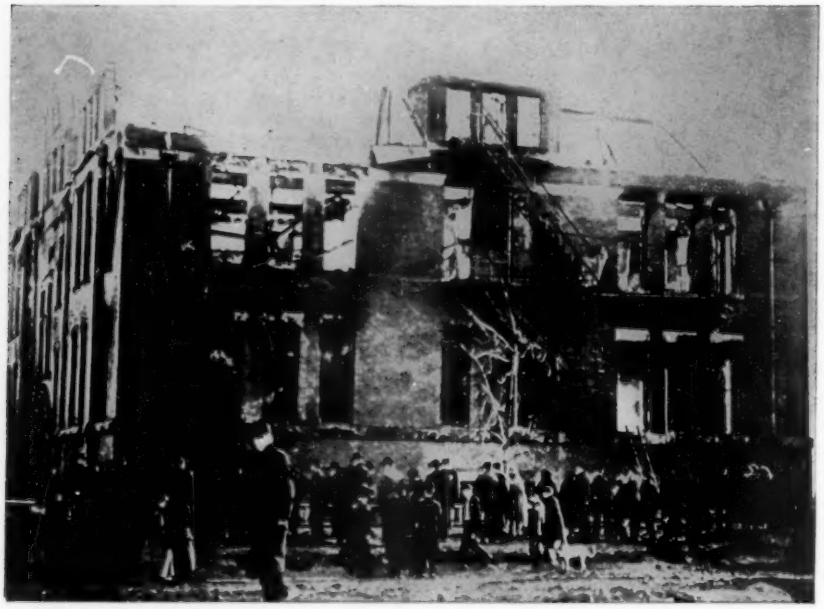
1. The health of the pupils will be improved; or
2. At no risk to the health of the pupils, the air conditioning system will relieve the teacher of diverting her attention to so many details secondary to instruction as to be worth the cost; or
3. At no risk to the health of the pupils, satisfactory air conditions will be maintained at a lower cost (installation and operation).

There exists comparatively little evidence of the relative output in health improvement of one type of ventilation over another. What evidence there is on this point does not show that mechanical systems of air conditioning in schools have produced anything superior to that obtained by natural means. As a matter of fact, it suggests the contrary, but by no means should this be interpreted as precluding the possibility of designing and operating mechanical systems which will compete on even terms with natural systems in so far as health is concerned.

It is quite possible that mechanical ventilation, through recirculation of a portion of the conditioned air, may be installed and operated at a lower total cost than natural systems, which turn the conditioned air out of doors after comparatively little use.

Finally, it must be emphasized that the success of the most scientifically designed and carefully installed system of air conditioning will depend on intelligent operation. No system that will not be run by competent persons, informed in the objectives of school air conditioning, is worth installation, and money invested in ventilation equipment, installed and not operated (and thousands of such instances can be found) is wasted.

Editorial Note.—Acknowledgment is due the American Society of Heating and Ventilating Engineers for the use of Figs. 3, 4, 5, 6 and 7, and the Peerless Unit Ventilation Co., Inc., for the use of Fig. 2.



Russell Sage Foundation

RUINS OF THE COLLINWOOD, OHIO, SCHOOL AFTER THE FIRE IN WHICH 173 PUPILS AND 2 TEACHERS WERE BURNED TO DEATH, ON MARCH 4, 1908

INTERIOR OF THE DEERING HIGH SCHOOL, PORTLAND, MAINE, AFTER FIRE OF MAY 21, 1921

This fire, which started in a closet used by the janitor to store personal belongings, caused the loss of one life. The photograph shows the type of wooden interior construction which was responsible for the rapid spread of fire through the building

Fire Protection for Educational Buildings

BY ROBERT S. MOULTON

TECHNICAL SECRETARY, NATIONAL FIRE PROTECTION ASSOCIATION

SCHOOLS are in a class with jails, in that attendance in both is compulsory. On account of this requirement there is a special public responsibility for the safety of children in the schools. The situation is very different from that applying to theaters, for example. The citizen who feels that any given theater is a fire-trap is at liberty to withhold his patronage. The parent who fears for the safety of his child in a fire-trap school has no recourse except through community action stimulated by an aroused public opinion. This public responsibility should be obvious, and it is being met to a marked degree in many parts of the country.

Despite this partial awakening, however, school fires continue to occur in the United States at the rate of five per day, and in all too many of these fires serious losses of life occur. An analysis of 500-odd school fires in which 423 lives were lost, reported to the National Fire Protection Association, leads to the conclusion that often those in authority have considered the problem of school fire safety purely from the viewpoint of dollars and cents, apparently feeling that their responsibilities have been covered by fire insurance policies. The danger of loss of life by fire, and the serious consequences of protracted interference with school sessions when school buildings are destroyed by fire, have apparently received too little consideration.

A Shell of Brickwork Does Not Make a School Fireproof

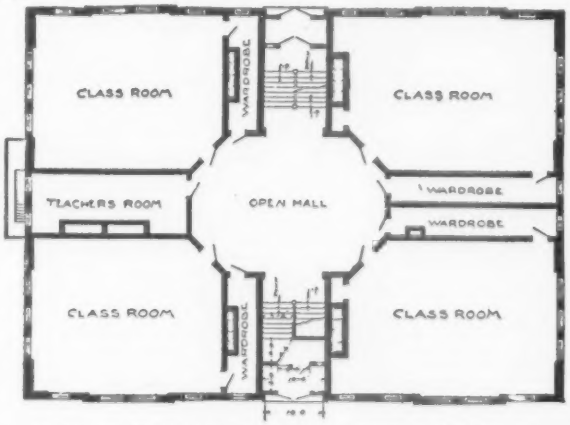
"Fireproof" is a misnomer frequently applied to buildings that are actually anything but fire-safe. Brick and other masonry have been recognized as "fireproof" from time immemorial, and quite correctly so. But masonry walls, no matter how substantial, are of little value from the viewpoint of fire safety so long as floors, partitions, stairways and other interior construction are of wood. It seems ridiculous to assume that a wooden structure will not burn merely because it is encased in a shell of brickwork; yet experience shows that this is a fallacy held by school boards and committees to an amazing extent. If the exterior of the building is of brick, stone or concrete, the school authorities and the public often seem satisfied that there is no danger from fire, and in some cases are even so firmly convinced on this point that no fire insurance is carried on the property.

Even the very best of building construction should not be described as "fireproof," according to the National Fire Protection Association, which has officially discontinued the use of this term on the ground that a serious fire is possible in a building even of the best grade of non-combustible construction, because the furniture and other contents will always furnish fuel for fire, and because steel and other incombustible building materials are all affected by fire of sufficient intensity and duration.

The modern trend in school building represents a distinct improvement in construction and exit arrangements over that prevailing a decade or more ago. Many of the more recently built school buildings are of first-class fire-resistive construction with ample exits. But there are still a large number of schools being built in which fire safety has not received sufficient consideration; where the exterior walls are of substantial construction, giving the semblance of fire safety, but where the interior is "built to burn." In some cities much has been done to improve the safety of the older buildings. Some of the more dangerous structures have been abandoned altogether for school purposes; others have been provided with automatic sprinklers and additional exits, and other fire-safety measures have been taken.

Safety from Fire Not a Matter of Construction Alone

Safety to life in schools is not a matter of construction alone. It depends not only upon the



FIRST FLOOR PLAN OF THE LAKEVIEW SCHOOL OF COLLINWOOD, OHIO

The plan shows the open hallway and the one fire-escape which saved the lives of most of the pupils on the second floor. The loss of life was caused by a jam in one of the vestibules shown

type of building, but upon the arrangement of the exits, the elimination or segregation of fire hazards and the proper arrangement of protection. Administration, the maintenance of proper housekeeping, and the efficient conduct of fire-drills are also matters of vital importance to this subject, which, however, will not be discussed in detail here.

Manual training rooms, domestic science rooms, chemical laboratories, etc., are frequent points of origin of fire. Heating plants and fuel storage rooms are likewise points of special hazard. Experience shows that fires occur in all sorts of unexpected ways and in unexpected places. Christmas trees, holiday decorations, and painters at work in halls or rooms, may be cited as examples of fire hazards that are seldom considered when school buildings are planned. The school principal should always bear in mind the possibility of fire from some unusual and unexpected source and be prepared accordingly.

Important Points Covered by the Building Exits Code

Of equal importance with the character of building construction is the arrangement of exit facilities. It is a fundamental rule of fire safety that there shall be two ways of escape from every area. If the fire occurs in one stairway, making it unavailable, there should be another stairway so located and arranged that it may be used with safety. Stairways should be enclosed or cut off in such manner that they will not serve as flues to spread the smoke and flames from one part of the building to another, and so that they may be available as exits when needed.

The features of school fire protection necessary to insure reasonable safety have been worked out in careful detail by a committee of the National Fire Protection Association operating under the procedure of the American Engineering Standards Committee. This committee includes in its

THE FRONT ENTRANCE OF THE PRINCIPAL BUILDING OF WELLESLEY COLLEGE, WELLESLEY, MASS., AFTER THE FIRE OF MARCH 17, 1914

The fire, starting in a chemical laboratory on the fourth floor at 4:30 A.M., swept through the open hallway shown in the picture, which served as a flue to spread the fire throughout the building. Two hundred girls asleep in the building at the time escaped without casualties, by reason of an excellent fire-drill. The building was a total loss

membership representatives of the fire protection interests, as well as the educational authorities, and represents the best judgment of a group of competent men who have earnestly studied this subject. The result of this work has been published in the Building Exits Code issued by the National Fire Protection Association, the same material also appearing in the National Education Association publication entitled "Schoolhouse Planning." The following features are some of the main points covered by this code:

Building Construction.—All buildings over two stories in height should be of fire-resistive construction throughout. In measuring the height of buildings for this purpose, the basement should be considered a story if the ceiling is 7½ feet or more above the ground level. The reason for this is that, if there is a high basement used for school purposes, the building becomes in effect a three-story structure, although designated as only two stories.

The interior wall and ceiling finish should be arranged to retard the spread of fire and, if wood stud construction is used, complete fire-stopping should be insisted upon.

A one-story building is safest from a life hazard viewpoint, but even in the one-story structure proper standards of construction should be maintained, for losses of life by fire have occurred even in one-story schools.

Fireman's Fund Record

A PORTION OF THE INTERIOR OF THE LINCOLN SCHOOL, SACRAMENTO, CALIF., AFTER THE FIRE OF APRIL 29, 1927

This was a large frame building and burned rapidly despite the best efforts of a well-equipped fire department

All heating plants within school buildings should be carefully segregated from the rest of the structure by fire-resistive partitions and ceilings. Likewise, rooms used for manual training, domestic science kitchens, laboratories, etc., should have fire-resistive ceilings when located on lower floors.

Exits and Fire-Escapes.—Not less than two stairways or smokeproof towers should be provided from every floor, including basements. These should be so arranged with respect to corridors that there are no dead ends where pupils

THE CHRISTIAN BROTHERS COLLEGE, ST. LOUIS, DESTROYED BY FIRE ON OCTOBER 5, 1916

The fire started on the fourth floor of this five-story brick joisted building and caused the death of nine men

may be trapped. These exits should be so located that there is at least one stairway or other exit within 100 feet of the corridor door of every room. All doors should be arranged to open with the direction of exit travel.

Stairs should be of proper pitch to make for safe use in emergency, and should be provided with proper hand-rails throughout. The recommended type of stair for schools has a maximum rise of 7 inches and a tread (exclusive of nosing) of 10½ inches. Stair construction should be incombustible throughout. No winding stairs should be permitted, as this type of stair is very apt to cause stumbling and lead to panic in case

THE LYNN, MASS., ENGLISH HIGH SCHOOL, WHICH WAS DESTROYED BY FIRE ON MARCH 29, 1924, WITH THE LOSS OF ONE LIFE

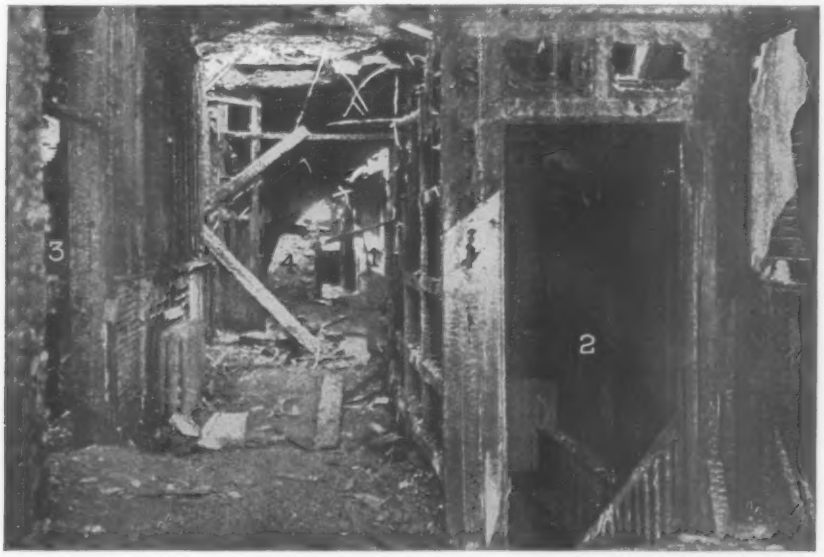
Vertical openings were responsible for the rapid spread of fire. Fifteen pumping engines backed up by plenty of water were unable to prevent the total destruction of the main building

THE BURNING OF DICKINSON HALL, PRINCETON UNIVERSITY, MAY 15, 1920
In this fire were destroyed irreplaceable works of art and historic collections. Automatic sprinklers would have prevented this loss

of fire. As previously mentioned, all stairways should be fully enclosed in fire-resistive partitions. While it is desirable to make these stairway enclosures and other construction throughout the building of a grade sufficient to withstand a serious fire, an enclosure of moderate fire-resistance is sufficient from the life safety viewpoint, as any children who are to escape by the stairways will do so during the early stages of a fire.

The number of stairways to be provided depends upon the population of the building and should be worked out in accordance with the definite rules given in the Building Exits Code. In most cases it will be found that the stairways necessary for ordinary operating requirements, if properly spaced and arranged, will furnish sufficient emergency exit capacity.

Fire-escapes should be regarded as at best only an expedient to remedy deficiencies in the exit capacity of old buildings where conditions do not justify the expense of providing additional inside



INTERIOR OF THE FIRST STORY CORRIDOR OF THE PAROCHIAL SCHOOL IN PEABODY AFTER THE FIRE OF OCTOBER 28, 1915, IN WHICH TWENTY-TWO LIVES WERE LOST

This photograph is taken from the point where the jam occurred. Fire started in rubbish in the basement, the flame and smoke coming up the basement stairway (2). Children coming down stairways from second story (1 and 4) and those coming through classroom doorway (3) met here and perished

stairways. There is no excuse, in designing a new building, for not providing enough inside stairs so that fire-escapes, which are at best a questionable means of exit, will be unnecessary. Where they are necessary, they should be "outside stairs," leading continuously to the ground, in all respects similar in pitch, width, etc., to the ordinary interior stairway; the ladder type fire-escape cannot be too strongly condemned. Approved slide escapes are also recognized for use on school buildings.

Fire-Alarms and Drills.—Every school building should be provided with an efficient fire-alarm system. This is a matter whose great importance is frequently overlooked by school authorities. The system must be of a dependable type, the home made "doorbell type" of fire-alarm being unreliable and sometimes worse than useless in an emergency. The National Fire Protection Association Committee on Safety to Life, after giving this matter careful consideration, has recommended that the alarm system provided, of whatever type it may be, should be used for fire-alarm purposes only. It should be entirely separate and distinct from the bells used for calling or dismissing classes. The individual type of system to be selected will depend upon local conditions. For the small school a mechanical gong, by reason of its reliability and simplicity, will be generally selected; for the larger school a carefully installed and supervised closed circuit electric system should be used. Where the school is within the area covered by a municipal fire department, a city fire-alarm box should be located directly outside the building. A system recommended for all schools with over 100 pupils is arranged to transmit an alarm to the municipal fire department simultaneously with the sounding of the interior gongs, upon the operation of any of the interior pull stations.

Local batteries are not required for this system, the operating current being obtained from two sources, (1) the building lighting circuit, (2) the municipal fire-alarm system. This is a specially desirable feature, as it eliminates not only an investment in a battery but, more important, the possibility of the system's getting out of order from neglect by the janitor, who in most cases has not sufficient electrical knowledge to properly maintain the battery.

The question of code is one frequently confronting officials in the selection of a schoolhouse fire-alarm system. The sole purpose of code is to denote location. To accomplish this naturally calls for more elaborate and consequently more expensive signal boxes and gongs. Therefore, the first question to be determined is whether or not it should be a feature. Where the school consists of only one building, there is no need for a code system. Here it is important to get out the occupants—the floor on which the fire is located being insignificant. On the other hand, if the school or college consists of several buildings, it is desirable to have a code signal because, in addition to emptying the buildings of occupants, it is necessary to indicate to the municipal fire department or private fire brigade which of the buildings is on fire.

Fire-drills are an essential feature of school fire safety. Without proper attention to fire-drills, panic and loss of life may ensue, no matter how much attention has been given to other features of fire protection. The purpose of a fire-drill should be to secure the orderly evacuation of a building in time of danger, primary emphasis being laid upon the control of the students rather than upon speed in emptying buildings of their occupants.

Fire Protection.—First aid fire protection, such as hand fire extinguishers, water pails, fire-hose, etc., is generally provided in school buildings as in any other class of property. Authorities consider, however, that it may be dangerous to have the teachers or students attempt to use such fire-extinguishing equipment prior to the evacuation of the building. The main emphasis should be on getting the children out of the building. After the children are safely out, attention can be given to fighting the fire. The main reliance in such cases should be placed upon the fire department and, while the teachers and janitors frequently do excellent work in handling incipient fires with the extinguishers and other means provided, there are very definite limits as to what should be expected in this connection. A line of hose pulled from a hose rack and stretched across the corridor might cause a file of children descending from the upper floor to stumble, form a jam and perhaps perish in the ensuing panic. Such "first aid" fire protection should of course be provided, but its limitations, especially in primary schools, should be recognized.

In general, the best fire protection available for school property is the automatic sprinkler system, which is of particular value because it functions automatically and requires nothing of teachers or pupils. A further advantage is that the sprinkler system, assuming always that it is provided with a proper water-supply, is on duty for twenty-four hours a day and may be counted on to extinguish incipient fires which occur outside of school hours. The records of the National Fire Protection Association show that, out of a total of 524 school fires over a period of several years, only a little over 25 per cent occurred while the school was occupied. While the only fires that are of any concern from the viewpoint of life safety are those occurring during school sessions, the fires occurring outside of school hours are of equal importance from the viewpoint of preserving the school property and maintaining the continuity of the school sessions.

EDITORIAL NOTE.—In addition to being Technical Secretary of The National Fire Protection Association (40 Central Street, Boston, Mass.), Robert S. Moulton, author of the foregoing article, is Secretary of The Committee on Safety to Life, which has jurisdiction over the Building Exits Code mentioned in the text.

Modern Plumbing Equipment for Educational Buildings

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ALONG with advancing standards of building construction and schoolhouse planning, plumbing standards are also rapidly developing. So rapid, indeed, is the development of new types of equipment that fixtures considered thoroughly up-to-date a few years ago are now obsolete. School men are paying more attention to plumbing installations in new buildings than formerly. As sanitarians and hygienists determine more and more specifically the ends to be sought in designing fixtures, manufacturers attempt to construct fixtures more and more in accordance with their criteria.

A careful review of the literature dealing with school plumbing and a careful study of new goods coming on the market show certain rather definite trends in the construction and installation of plumbing equipment for public schools. Only a few of the most clearly marked trends are mentioned in this article.[1]

Location

Toilet Rooms.—In locating toilet rooms, good light, ample ventilation, accessibility, and supervision should have major consideration. School men and hygienists have for a good many years been pointing out the necessity of ample light and ventilation in the toilet rooms.

"No room in a school building demands more light and sunshine and better ventilation than the toilet room."[2]

In spite of the forceful arguments and repeated pleas for good light and ventilation, school buildings are still being built with the toilet rooms in the basement. The best architects, however, no longer make such plans, and critical school men no longer accept a building plan that calls for toilet rooms in the basement.

There should be toilet rooms for each sex on each floor of the building and they should be located convenient to classrooms so as to be most easily accessible to the greatest number of children during school hours. This tends to relieve congestion and provides for ease of supervision. Separate toilet provisions should be made for the administrative offices, medical inspector and nurse's room, teachers' rest rooms, kindergartens, janitor's and engineer's rooms, and special classrooms, particularly classrooms for subnormal or crippled children.

Segregation of the sexes can usually best be handled by placing the rooms for the two sexes at opposite ends of the building. The entrances to these rooms should be screened, so as not to expose the room to view when the outer door is opened. The outer doors should be clearly labeled to indicate the sex for which the rooms are intended.

The plumbing for the toilet rooms should be laid open and exposed in a utility corridor. The supply lines, valves and the entire branch sewer should be fully exposed in this corridor so as to facilitate adjustment or repairs. The floor of the toilet room may be raised a foot or two in order that all the soil lines may be laid above the main floor level. The utility corridor should be wide enough for workmen to enter and work with ease. A width of 2 feet is considered ample. The utility corridor should be tightly closed and should be entered by a tightly fitting door. For ventilation purposes, the utility corridor should connect with an exhaust duct which is entirely separate from the exhaust ducts from other parts of the building. No fresh air should be supplied to the toilet room except through the windows and doors. A number of small registers or grills may be placed in the wall leading to the utility corridor, or ventilation may be secured through the fixtures themselves. In either case there should be a number of them in the room and they should lead to the utility corridor, whence the foul air is exhausted through independent ducts leading to the outside of the building. These ducts should be connected with an exhaust fan or should have aspirating coils in them in order to keep a constant current of air moving from the toilet room.

Toilet rooms should be long and narrow, with windows on the long side. A width of from 12 to 14 feet is ample, and the length of the room should depend upon the number of fixtures to be installed. The idea should be to have each and every fixture well lighted directly from outside natural light, and these should receive direct sunshine during a part of every day.

Drinking Fountains.—Drinking fountains are best located in the corridors of the building. This allows a maximum of supervision and provides for easy accessibility. They should be located on each floor, and in large buildings there should be several on each floor. The idea should be to place them convenient to classrooms, playrooms,

[1] For a more complete discussion of the criteria and a more adequate set of standards covering all phases of school plumbing, see: Thomas, Minor Wine: "Public School Plumbing Equipment"; Bureau of Publications, Teachers College, Columbia University, New York. 1928.

[2] "The Public School System of San Francisco, Calif." Bulletin 46, United States Bureau of Education, Washington, D. C. 1917.

gymnasium and playgrounds. The practice of locating them in toilet rooms is very objectionable, as toilet rooms are intended for other purposes.

Showers.—Showers should be located in some part of the building away from classrooms and easily accessible to the gymnasium and swimming pool. Good natural light and ample ventilation are essential. Placing them in a dark, poorly ventilated basement is certainly contrary to the general principles of sanitation.

Lavatories.—Lavatories should be located at various places in the building to meet the needs of children who want to wash their hands. Economy of time and distance should be considered. The idea should be to so place lavatories that children will be encouraged in the practice of washing their hands whenever they are soiled. If lavatories are too sparingly provided, it will be difficult to induce the children to keep their hands clean.

All toilet rooms should be provided with lavatories, and, in addition to the toilet rooms, lavatories should be placed in or near teachers' rest rooms, shops, laboratories, boiler rooms, forge rooms, doctor's offices, nurse's rooms, principal's offices, kindergartens, janitor's rooms, lunch rooms, sewing rooms, art rooms, etc.

Sinks.—Sinks are of so many kinds and serve such a variety of purposes that their location can best be determined by the uses to be made of them.

All school buildings should have janitor's slop sinks located in closets on each floor. They should also be provided in the engineer's room. In such special rooms as pottery rooms, shops, laundry, forge rooms, art studios, lunch rooms, and all domestic science and natural science laboratories, sinks should be provided.

In domestic science laboratories, small sinks are needed for students, and, in addition, at least one large pot sink should be provided. In lunch rooms, provision should be made for a large pot sink, a vegetable sink, and a meat sink. In the natural science laboratories, such as general science, biology, physics, and chemistry, sinks are needed at the instructors' desks, in storerooms, in preparation rooms, in instructors' rooms, and in the laboratory for general purposes. In the chemistry laboratory, sinks are needed at the students' desks; and in the biology department, sinks are needed in the aquarium and plant rooms.

Swimming Pool.—Indoor swimming pools present a technical engineering problem concerning which experimentation is being conducted. The problem of providing a large pool that will be absolutely impervious to water and will not crack and leak with the settling of the building or ground, requires the technical advice of a competent engineer who will study each case separately.

Swimming pools are intended as places for wholesome, vigorous and healthful exercise. Ample light and abundant ventilation are therefore necessary. Location in dark and poorly ventilated basements is very objectionable. The shower rooms should be near the swimming pool, so that all persons may take a complete shower-bath with soap, in the nude, before entering the pool.

Arrangement

Toilet Rooms.—In arranging the fixtures of the toilet rooms, the chief items to be considered are: accessibility, seclusion, privacy, supervision, light, ventilation, ease of cleaning fixtures, ease of cleaning floors and walls, absence of hidden surfaces, and general appearance. As mentioned before, toilet rooms should be long and narrow, with the windows on the long side. The fixtures should be placed in a single row along the wall opposite the windows, except the lavatories, which should be along the outside wall under the windows. The urinals in the boys' rooms should be placed nearest the door and the water-closets farther away. Water-closets should be placed in separate compartments, with dwarfed partitions and doors. The partitions should be from 5 to 5½ feet high, set 1 foot above the floor. The urinals should be separated by partitions extending 18 inches from the wall. The doors to the water-closet compartments should open inward and be so arranged as to remain open when not in use, thus exposing the fixture to the light.

The lavatories should be placed near the door and directly in front of the water-closet and urinals. This will tend to offer the suggestion, "Wash your hands" after leaving the compartments. Extreme care should be exercised to make sure that there are no surfaces of any part of the room or fixtures which are liable to soiling, hidden or only partly exposed. Every part of the room and every part of every fixture that is liable to soiling of any kind, should be fully exposed, so as to aid in cleaning. Bad odors in toilet rooms are largely due to hidden surfaces which become soiled.

Showers.—The shower-heads for both boys and girls should be placed in individual booths, with dwarfed partitions raised above the floor. They should be near dressing booths and lockers. Hot and cold water should be mixed and under thermostatic control so as to prevent scalding. The temperature should be individually controlled up to a certain maximum, at which temperature the thermostatic control checks the flow of hot water.

Materials of Floors, Walls and Partitions

Toilet Rooms.—The floors, walls, stall partitions, and wainscoting of toilet rooms are subject to soiling by careless users; hence, great care should be exercised in selecting materials best suited to these needs. A very common cause of bad odors in toilet rooms and one that is very difficult to remedy is that of floors or walls being saturated with urine.

All of the materials used in finishing toilet rooms should be non-absorbent. Wood and portland cement are very objectionable here. They absorb liquids and are very hard to keep clean.

Flint tile laid in waterproof cement makes a very good floor. Wainscoting should be of some such material as vitreous tile or opaque glass. It should be non-absorbent, so as to prevent its becoming saturated with liquids; smooth, so as to be easily cleaned; light-colored, so as to reflect light, and reveal dirt; of hard surface, to prevent defacement; and durable, because hard usage is to be expected.

Marble is one of the most expensive materials used for wainscoting and stall partitions, but it has several decidedly objectionable features. It is absorbent, easily stained, rather soft, and may be scratched with a knife or written upon with a pencil unless it is very highly polished.

Sheet steel, if kept well painted, is relatively non-absorbent, but it is rather easily scratched and unless kept well painted will corrode. Corrosion causes roughened places which are hard to clean and are unsightly.

Probably the best material yet devised for wainscoting and stall partitions is opaque glass. This material has various trade names, such as Carrara Glass, Vitriolite, and Sani-Onyx.

Defacement of walls and partitions in toilet rooms has been a problem for many years in school buildings. Some school men have taken the position that the practice is to be expected and that the best way to control it is to have the janitor inspect the rooms every day and erase or paint out any defacement found. It has been the experience of other school men that if the toilet rooms are light and clean, and of the right kind of materials, the whole atmosphere pervading them will be more wholesome and will tend to discourage or do away with this practice. The latter view is held by the writer.

Type of Fixture

Drinking Fountains.—In selecting the type of drinking fountain best suited to school needs, the following items are of chief importance: The fountain should be of the type supported from the wall rather than the pedestal type because the floor is more easily cleaned and the height may be more readily adjusted to the height of the children who use them. From the sanitary standpoint, it is essential that the lips of the user should not touch any part of the jet from which the water issues. The stream of water should issue from the side of the bowl and be about in the form of a parabola, reaching its greatest height approximately at the center of the bowl. By this arrangement, any water that has touched the mouth of the user, will not fall back upon the jet but will fall in the center of the bowl and run out of the drain. The bowl should be large enough, and the stream should be so regulated that water will not fall on the floor. The controlling lever should be on the outside of the bowl, so that the hands will not get wet when using it. The orifice from which the stream of water issues should be protected by an extended lip on the side of the bowl, and be recessed so as to render it difficult for a child to partly close the jet with the finger, thereby concentrating the pressure on a small opening and squirting water on the floor or other children.

Lavatories.—The type of lavatory supported from the wall by a concealed chair or hanger is superior for school needs to the pedestal type because of the greater ease of cleaning the floors and walls around it. The lavatory should be made with an integral trap and back. There should be no stopper or pop-up waste, and no overflow. It should be so arranged that the child can wash in running water and not in a bowl of water. There should be no cock holes and no faucets on the lavatory at all. Water should be supplied from a spout that is placed above the back and admits the water in a small stream or heavy spray. This spout should be connected with a device on the order of a flush valve so that when the lever is pulled, a small amount of water will issue and the valve close automatically without any attention on the part of the user. Warm water should be supplied, and controlled by a thermostatic mixer.

Such a device is more sanitary than the usual type, because there is a minimum of parts or surfaces to become exposed to soiling. The child is forced to wash in running water and there is a minimum of parts to collect dirt. It is more economical in water consumption, because the water is supplied in a small stream, and the valve will close automatically. The height of the lavatory can be regulated as desired.

Sinks.—The type of sink to be selected for school purposes should be determined by the use to be made of it. Careful forethought and analysis of the needs will greatly aid in making the selection.

For certain purposes, sinks are needed that are large enough to hold large vessels such as pots, pans, buckets, etc. Other sinks, such as those for dish washing, should be deep enough to prevent splashing and also deep enough to hold sufficient water. For many purposes it is desirable to have integral backs to prevent splashing the wall. In sinks for chemistry laboratories, provision should be made for shelves for the purpose of collecting gases under water.

Showers.—Considerable objection has been raised to the shower-head's being placed directly overhead, because this necessitates wetting the hair. A better arrangement is secured by placing the shower-head at about shoulder height on the side of the booth, on a ball and socket joint, so arranged by valves in the booth that they may be operated either as a gang or individually. The entire group of showers in a room should be controlled by a thermostatic mixer so that water beyond a certain maximum temperature cannot pass to the shower. If, instead of one shower-head, two or three at different heights are placed in a booth, then children of different heights can select the shower-heads best suited to their respective heights. If small children are bathing, the showers may all be controlled by one person if desirable,

and when larger pupils are bathing, each shower can be controlled by the user. The advantage of the side spray is that the head need not be wetted. The ball and socket joint makes it possible to direct the stream of water at the most desirable angle.

Fire Hose and Standpipe.—An important question to consider when placing apparatus for fire protection in a school building is: For whose use is the apparatus intended? It is foolish to expect the ordinary woman teacher to handle a 2½-inch hose when connected to a standpipe carrying water under heavy pressure. Only strong and well-trained men can successfully handle such a hose. However, standpipes with valves on each floor should be located in the building so that no part of the building is more than 50 feet distant from the standpipe. Each standpipe should have on each floor a valve and connection for regular 2½-inch fire company hose. Fire companies always bring their own hose with them and seldom rely upon the hose at the school, which may be old and useless. Each standpipe on each floor should also be fitted with a 1½-inch valve and connection and 50 feet of 1½-inch hose on a rack or reel enclosed in a cabinet. This 1½-inch hose can be used by the teachers until the fire company arrives. In each cabinet there should be a chemical fire extinguisher.

Water-Closets.—The type of water-closet combination best suited to school needs is the blow-out type with large water surface in the bowl, a minimum of exposed surface above the water level, a large waterway, an oval shape of bowl with extended back and front lip, with seat of full saddle pattern, open back and front and flushed by individual flush valves. For larger children, the wall-hung type is to be preferred on account of the greater ease of cleaning the floor around them. For smaller children they should be of the pedestal type and fitted with sanitary cove base. The flush-valve should be placed behind the partition in the utility corridor and only the handle exposed. The particular advantages of the blow-out type are simple construction, positive action, and a minimum of stoppage. There is only one bend in the waterway and the smallest part of the waterway is at the bowl opening; thus anything that can enter the waterway can pass on through. The large exposed water surface tends to eliminate soiling of the fixture, and the saddle pattern seat causes the body to be placed in the proper position over the bowl.

Urinals.—The type of urinal recommended is a small vitreous china wall hung fixture about 18 inches wide and 24 inches long, with extended front lip, integral flushing rim and trap, 1½-inch waterway, flushed by flushometer valve placed behind the wall in the utility corridor with only the handle exposed and set at the proper height above the floor. Where two or more are placed together, they should be about 30 inches apart, center to center, and separated by shields of opaque glass, extending 18 inches from the wall.

The chief advantages of such a type of urinal are: a complete flush of the entire soiling surface with each use, to keep down odors; all fouling surface plainly exposed to view to facilitate cleaning of the fixture; the conservation of water because it is flushed only when used; a reduction of stoppage through large waterway; the regulation of height to suit the needs of children of various heights; location above the floor to facilitate cleaning the floor and also to allow a boy to stand close to it; the use of small size to reduce exposed surfaces and facilitate cleaning.

Height of Fixtures

The height at which plumbing fixtures are set is an important matter and yet it is one that too often is overlooked. It is not hard to find schools where the drinking fountains are almost as high as the heads of some of the children, the lavatories shoulder-high, and the water-closets almost waist-high. It is obvious that children cannot use fixtures with ease or satisfaction if placed too high.

Lavatories.—A lavatory should not be so high that a child has to bend his arms upward from the elbow to reach over the top of the basin. In order that the forearm might not rest upon the rim, the fixture should be placed low enough for the forearms to bend downward from the elbow when washing. If the face is to be washed, the fixture should be low enough so that when the body is bent forward and the head is over the bowl, the forearm may still be bent downward when the elbows are held close to the trunk.

In a careful study of this problem, Thomas found that the proper height of lavatories for kindergarten children is 18 inches; for elementary grades 1 to 6, 18 to 28 inches; for junior high school grades, 28 inches; and for senior high schools, 30 inches.[1]

Water-Closets.—There are excellent physiological reasons why water-closets should be low enough so that a child's feet rest squarely on the floor when using the fixture. In addition to the physiological, there are other reasons why closets should not be too high. It seems obvious that they should be low enough so a child can sit upon them and rise from them without having to slide on and off. The necessity of a child's having to slide on and off the seat is one cause of his soiling the seat. This also makes the child himself more liable to soiling.

Thomas has shown that the total height from the floor to the top of the water-closet seat should be not greater than 9 inches for kindergarten children, for elementary children from 10 to 12 inches, and for junior and senior high school children from 12 to 14 inches.[1]

There is little or no disadvantage in seats being lower than the heights mentioned, but greater heights are very objectionable.

[1] Thomas, Minor Wine: "Public School Plumbing Equipment"; Bureau of Publications, Teachers College, Columbia University, New York.

Urinals for the kindergarten should be about 12 inches from the floor; for the elementary grades they may be placed 20 inches, and for senior and junior high schools, 22 inches above the floor.

Materials of Fixtures

The materials of which plumbing fixtures are manufactured should be such that will not craze or crack; they should be non-absorbent, non-corrosive, strong, durable, impervious, smooth and of light color.

The best material yet found for drinking-fountain bowls, lavatories, water-closet bowls, and urinals is genuine vitreous china. Vitreous china is also best suited for sinks to be used for certain purposes. However, for sinks where very rough usage is to be expected, such as boiler room, forge room, and some shops, material should be chosen that will not break so easily. Cast iron is preferable to porcelain. Porcelain is porous and absorbent as soon as the glaze is cracked.

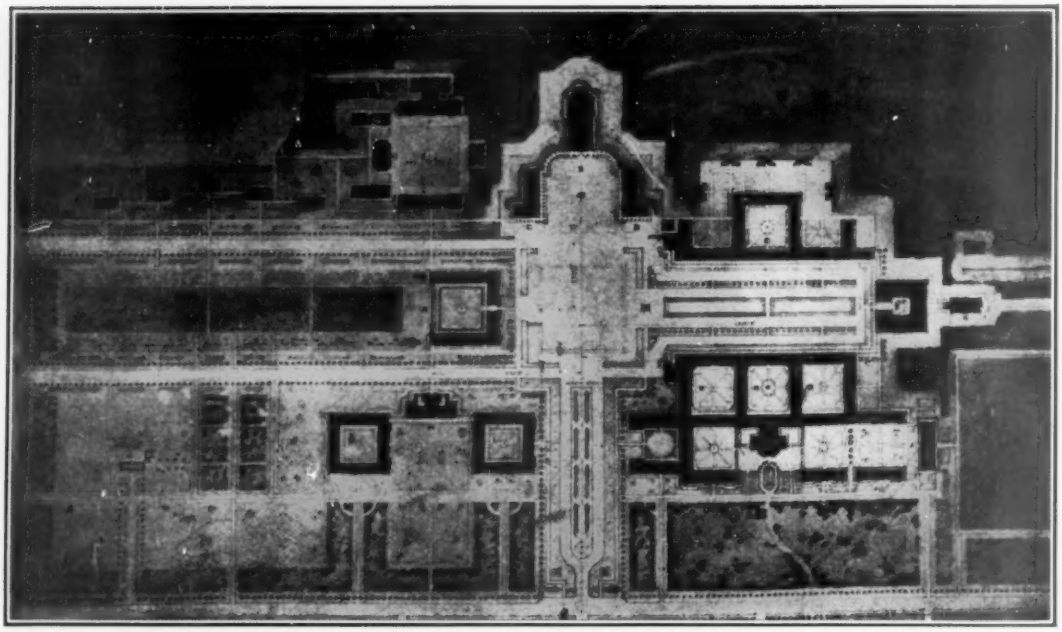
The metal fittings should be of good-grade brass. The best finish yet found for metal work is a compound of chromium. This finish is sold under various trade names, such as Crodon or Chromoid. It is very superior to nickel, as it will not scale and is very much harder. It will not tarnish and cannot be scratched by cleaning compounds.

The best material for water-closet seats is genuine hard rubber.

Number of Fixtures

The number of fixtures installed in school buildings varies rather widely in different parts of the country. The following table of recommendations is taken from "Public School Plumbing Equipment," by Thomas.

No. Pupils	Girls' Water-Closets	Boys' Water-Closets	Boys' Urinals	Lavatories in Toilet Rooms
100	7	4	5	2
200	12	7	9	4
300	16	9	13	6
400	19	11	15	7
500	21	12	17	8
600	24	13	19	9
700	26	15	21	10
800	29	17	23	11
900	32	18	25	12
1000	34	19	27	13
2000	59	32	48	23



PROFESSOR WATKIN'S GENERAL PLAN FOR TEXAS TECHNOLOGICAL COLLEGE

Texas Technological College, Lubbock, Texas

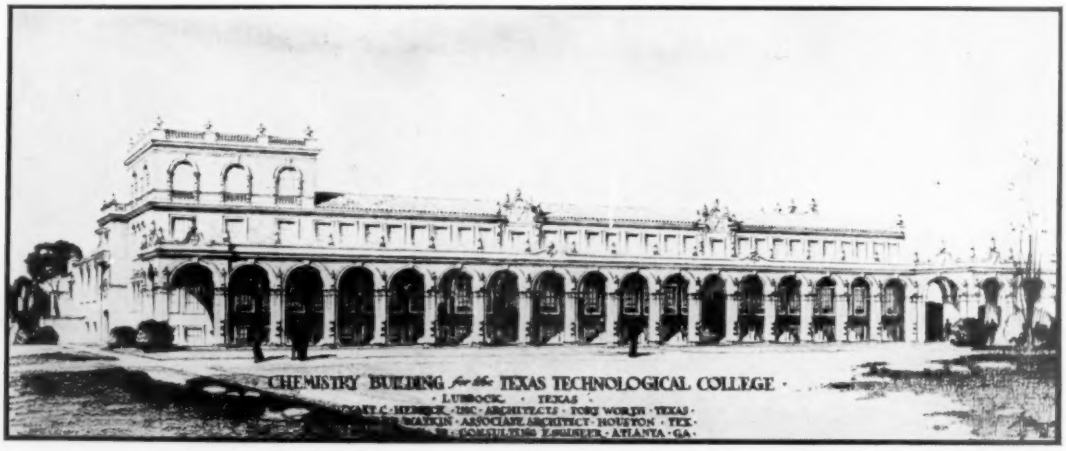
BY WILLIAM WARD WATKIN

PROFESSOR OF ARCHITECTURE, RICE INSTITUTE, HOUSTON, TEXAS

THE miracle and majesty of the great state of Texas will always hold for youth the abundant promise of unbounded opportunity. The beginnings and growth of the new College of Technology at Lubbock picture with remarkable accuracy the faith in education which parallels all public development in Texas. Over the archway leading into the courtyard of the academic group are engraved the words of Mirabeau B. Lamar, "Cultivated mind is the guardian genius of democracy."

That one may feel the modern spirit of Texas, it is only necessary to recount without elaboration the events in the brief history of this new State University of Texas.

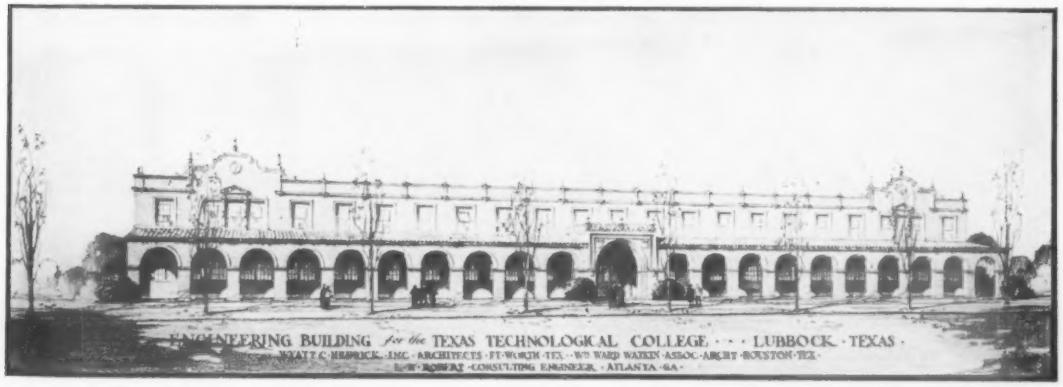
In the year 1924, by act of the State Legislature, there was created a third state educational foundation of collegiate and university intention. It



was to be located in the town of Lubbock in the extreme western, almost extreme northwestern, portion of the Panhandle section of the state. So situated, it was a full twenty-four hours' journey by through express train from the capital of the state and from each of the other two state universities, Texas University at Austin and Texas A. and M. College at Bryan. Its avowed purpose was that of a university to be well established in its college departments and in its agricultural department, but with primary emphasis upon the School of Technology. This latter function was first interpreted by the establishment of the most modern and most completely equipped textile school in the entire South.

With a site of four square miles immediately adjacent to the town of Lubbock and with an initial appropriation of one million dollars for buildings, the problem of its building was undertaken. Dr. P. W. Horn, former President of Southwestern University, was selected as President by a board consisting of capable and far-seeing citizens selected from the leaders of industry, banking and agriculture in the state. With the vision of this board, the general plan was prepared for a college which would ultimately function smoothly and well when its student body should number 5,000. That was the Texas vision: from the bare plains partly covered with fields of cotton in 1924, to a university of many complete and specialized buildings caring for a great student body of 5,000 in 1950. To such an end the general plan was prepared in the spring of 1924. In the fall of

STAIRWAY LEADING TO LIBRARY IN ADMINISTRATION BUILDING


ENGINEERING BUILDING for the TEXAS TECHNOLOGICAL COLLEGE · · · LUBBOCK · TEXAS ·
WYATT C. HEDRICK, INC. · ARCHITECTS · FT. WORTH · TEX. · · WM WARD WATKIN · ASSOC · ARCHT · HOUSTON · TEX ·
· CONSULTING ENGINEER, · ATLANTA · GA ·

THE COURT OF THE ADMINISTRATION BUILDING, TEXAS TECHNOLOGICAL COLLEGE

1924, the Administration Building, the Textile Engineering Building, the Power Plant, the Building of Household Arts, and the first of the agricultural buildings were begun; each in turn a part, but only a small part, of a greater and more complete building definitely planned for each of these specific purposes.

In September, 1925, the college opened to a Freshman class numbering 950. All records of the beginning of a new university were completely shattered. In the three years of its history the Texas Technological College has made positive the accurate vision of its founders. Its enrollment now numbers in excess of 2,000 students in regular session.

The central unit of an Engineering Building has just been completed. The Laboratory of Chemistry is approaching completion. The Library is about to be started. The Academic Court is to be completed in 1929. Each building is planned as the ultimate building and built in part only. Each is of permanent and thorough design and construction. Each is rich in significant detail and ornament. Each is part of an ultimate panorama of beauty in which every building shall exist as part of the complete scheme rather than as a separate and distinct unit.

The plan is entirely in the spirit of the University. Its campus, a mile in width and more than a half a mile in depth, opens with its main axis the continuance of a 4-mile boulevard 200 feet in width leading directly from the Court House Square in the city of Lubbock to the future Commencement Hall of the College. Lubbock, a town of 3,800 people in 1920, is a city of 24,000 people today, and has public buildings comparable with those of an older city of twice that population.

The great Court before the Administration Building is 650 feet square; the Court of Technology, terminating at the Textile School and ultimately flanked with engineering buildings on both sides, is 900 feet long by 360 feet wide; the Court of Honor at the head of the main axis consists of the flanking buildings of Chemistry on the left and Physics on the right, with the Commencement Hall at the center. This Hall will be the Hall of Fame for the state of Texas, if the wisdom of the founders of the College is fulfilled.

The entire college is in architecture reflecting the Spanish history of the earlier days of Texas. The climate and physical environment of Lubbock are quite similar to those of central Spain. It is our thought that the Commencement Hall shall be a glorified Alamo; the center and heart of a modern drama of Texas in which in the fine spirit of manhood written at the historic Alamo, the future youth of the great west Texas where true manliness and independence reign supreme, shall go forth to a motto as of Lamar, "Cultivated mind—it is the only dictator that free men acknowledge and the only security that free men desire."

The Robert A. Long Complete School, Longview, Washington

BY WM. B. ITTNER, F.A.I.A.
St. Louis, Mo.

THE educational and building policy of combining all grades in a large centrally located unit to take the place of several small buildings with grade segregations has been adopted by a few new and rapidly growing cities. Longview, Wash., the Long-Bell Lumber Co.'s four-year-old town in the Northwest, has joined the group of small cities employing this plan of centralization. The principal reason given by the Board of Education may be summed up in the following brief statement:

"The plan adopted enables Longview to offer enriched educational opportunities to a far greater number of children at a minimum cost. The educational curricula of both elementary and high schools call for gymnasiums, auditoriums, workshops, libraries and cafeterias. These special rooms are no longer educational accessories but just as essential as classrooms. To provide several of these large units in a number of small schools becomes prohibitive as to costs. It is only by means of a centralization building policy that these newer educational facilities become financially possible."

A connected three-building group located on a 39-acre site constitutes Longview's initial centralized school plant. Pupils from the Kindergarten through the Senior High School will attend this school. The plant will also serve the community for assembly hall purposes, and as a recreational, vocational and health center. The Senior High School, the central and dominating unit of the group was completed June 1. It accommodates 1,200 students. This unit contains the large school and community auditorium, with seating capacity for 1,200. The two wing buildings will house the Junior and Elementary grades with enrollments of 800 students in the Junior and 600 in the Elementary School.

THE CENTRALIZED THREE-BUILDING SCHOOL—KINDERGARTEN TO SENIOR HIGH SCHOOL, LONGVIEW, WASH.

A Comprehensive Equipment for Life Training

Longview's new school, with its enriched facilities in the form of gymnasiums, playgrounds, libraries, classrooms, shops and laboratories, provides an environment wherein the cardinal principles of present-day education may be realized. For the health activities, two gymnasiums, a sunny elementary school playroom, shower-baths, clinics and playgrounds are provided. There are classrooms and a library-study room in each unit for the fundamental subjects. Two small supplementary auditoriums in the High School and one in each of the smaller units in addition to the large school and community auditorium supply a wealth of opportunity for music, dramatics, group activities, visual instruction and the social sciences. The plans reveal an unusual layout of laboratories, art rooms and workshops for the purpose of opening the door to the great field of science and industry, to assist in the choice of a life vocation, and to encourage habits of thrift and those characteristics essential to good citizenship.

The architecture of the group reflects the Colonial, since Longview is, in the strictest sense, an American city, there being but a small percentage of foreign-born citizens. Inside and outside, the school radiates dignity, grace and charm. It is a work of art and adds to Longview an important architectural and civic asset.

Certain Features

A few interesting and extraordinary details as revealed by the plans and specifications are the following:

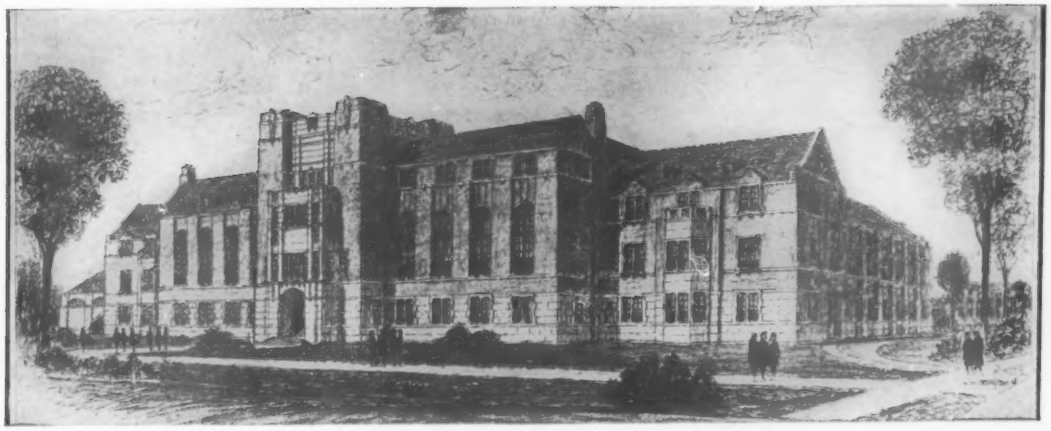
1. The large auditorium has a fully equipped stage with overhung scenery, with the most modern lighting effects and provision for grand organ and motion pictures.

2. The supplementary auditoriums are equipped with stages and picture booths. Small community groups will use these rooms when not used by the school.

3. The library-study room in the High School accommodates 200 students. It is 24 x 140 feet and will be wainscoted with bookcases.

4. The gymnasiums in the Senior and Junior Schools are provided with movable partitions, so that there may be segregation of boys and girls. A full complement of lockers and showers is provided for the school's use, and extra showers have been installed for community use.

5. The cafeteria, 38 x 164 feet, serves pupils from all three units. It has a high wood wainscoting and an open timber roof after the manner of the refectory rooms at Eton College.



THE UNIVERSITY OF MICHIGAN LEAGUE, ANN ARBOR

The Union and the League

BY IRVING K. POND, F.A.I.A.
CHICAGO, ILL.

MISS JANE ADDAMS was once serving on an international jury in Paris. A noted Frenchman inquired of her as to her qualifications for the post. These lay along the line of her work in a social settlement, but he could not understand. Incidentally, as illustration, mention was made of Hull House. Said the "Monsoo" with a gleam of comprehension touching his features: "Ah! You are connected with a hull house! If you had only said so at first!—Now I understand!" To him "a hull house" was the generic term embracing all social settlements and their work.

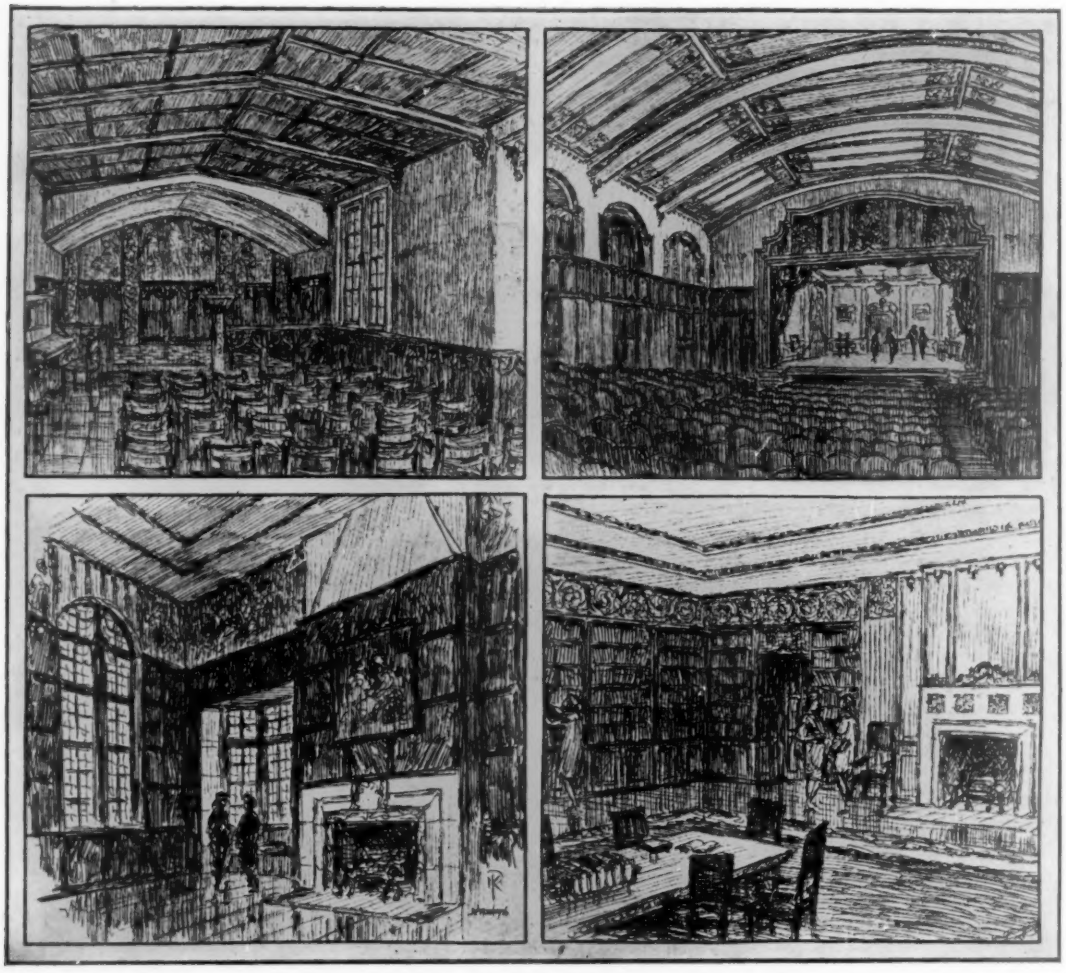
And now the term "Union" has come quite generally to have a definite and limited meaning when used in conjunction with college life and ideals. Soon "League" will come to have one also. The Union, in the male college and in the coeducational college, with at least one notable exception, has come to denote the building which houses the social and extra-campus activities of the institution—and, too, the organization which carries on and directs these activities. In general, the Union in coeducational colleges is used by men and women on equal terms, with minor portions of the building set aside for the particular use of each of the sexes.

In the one exception noted, the Union is predominantly for the men; women enter and are entertained only as guests. At this institution a building is in process of erection predominantly for the use of women—men entering and being entertained only as guests. This building (and organization) is known as "The League"; and that term may come in time to be expressive of women's activities in all women's colleges. The terms "Alumni Hall" and "Alumnae Hall" are not broad enough to cover the uses of the buildings or the scope of the organizations. It is true that in most cases the alumni or the alumnae take the initiative in organizing the bodies and in procuring funds for the erection of the buildings—especially true in state colleges and universities and generally true in the endowed colleges. Up to quite recently, if indeed now, the state has not deemed that it is called upon to aid its youth in a way to make them more than merely efficient cogs in the body economic. The state fits its youth to make a living—not for life. Not so long ago the state did not see fit to furnish gymnasiums, the legislative committees maintaining that the student might well get all necessary exercise in sawing wood, shoveling snow, waiting on table—and earn something in getting exercise; always the economic factor—never a thought of the amenities of life and the great things to be gained by social contacts—the great things, spiritual things, to be gained through contacts in the fields of sport. Today students and alumni build the stadia.

But in the Union and the League, students and alumni gain social contacts and gain by them. The individuals know each other and how to work and to play with each other, and gain, many of them, their first inkling as to the value of social contacts out in the great world—not the mincing contacts in so-called "society," but the actions, reactions, and interactions in the great world of politics and business, of scientific and artistic achievement. The Union and the League are not club-houses for the loafer or the dilettante, but hot-beds for the propagation of ideas, for the fruition of ideals, for the sprouting of the seeds of character and friendship.

Everything to be found in a well-equipped clubhouse is found in the Union or the League Building. Sometimes other items are catalogued; as, for instance, the theater and the spiritual "rest room," which might be called a chapel for want of a better word. Where college authorities do not furnish an adequate swimming pool, the Union may be called upon to do so. In the University of Michigan League, which is now building, a little theater (680 seats) equipped for scientific or art or popular lectures is included, as is also a small chapel in which quiet contemplation and self-communion may be indulged in. Bedrooms and dormitory spaces are provided for the alumnae and guests, and a memorial library invites to the enjoyment of good literature. An alumnae room welcomes the returning daughters of their Alma Mater; and a lounge for women alone, and another equal in size for men and women in common, extend hospitality. At Michigan the accommodations provided for the entertainment of men in the League building are more extensive than those for entertaining women in the Union. The reason is not far to seek and cannot be blinked. The male creature does not depend on the opposite sex for his social contacts and reactions; the existence of boundless lodges, fraternal organizations, and such-like proclaims that. Where the male is wanting, the woman, especially the young woman, bobs her hair, adopts mannish airs and stride, and soon will cultivate the pipe. The women of Michigan are womanly, and frankly accept man as a desirable if not necessary social adjunct. But there are sacred spaces in the League where man may not enter. Both Union and League are equipped with large assembly rooms to be used in common when desired for dances, banquets, concerts and lectures.

The presence of this type of building on the campus of our great institutions of learning proclaims an awakened social consciousness and admits that not book learning alone, even with laboratory experiment, can prepare one for that larger life to be lived by man as a social creature.



INTERIOR OF THE UNIVERSITY OF MICHIGAN LEAGUE

Population and School Planning

BY FRED ENGELHARDT

PROFESSOR OF EDUCATIONAL ADMINISTRATION, UNIVERSITY OF MINNESOTA

THERE are but few administrative activities engaged in by the public school executive which do not involve the population. Every major plan made must be considered in terms of the present and future effect which the plan will have upon the people. There is no business, public or private, in which the general welfare of the populace is so intricately interwoven with the management of enterprise as in the case of the schools.

Population Change and Educational Planning

Changes in population totals within a school district, as well as within a given section of the district, play an important part in determining educational plans. One has only to visit the typical American city to appreciate fully the significance of this statement, and to observe the conditions resulting from the failure to recognize its importance. It is a rare school system of more than one building in which the educational program could not be more effectively and economically carried on in fewer structures. Indeed, it is extraordinary in any city to find the schools constructed prior to 1915 located in proper relationship to the population they are endeavoring to serve.

These conditions, coupled with the increased cost of public education caused by the added burdens placed upon the schools through the complexities associated with city growth, have forced the attention of responsible authorities to discover the relationships which exist between the population changes and planning. The outcomes, as one would expect, have been a number of techniques devised to determine futures in population totals as well as their distribution over a given area.

Population and Current Educational Programs

Anticipating the future in public school administration requires information regarding the attitudes of the people and the educational needs of the public, as well as the numbers to be served. The managerial activities which require information concerning population may be divided into two general categories: those which are concerned with the current educational affairs; and those which can be related to the plant program. For planning the current program, some method must be devised which will give, for two or three years in advance, accurate detailed school population facts for each organization unit, as well as totals for the schools as a whole. Otherwise, an effective and economical budget cannot be prepared.

Population and Plant Program

Plant program planning can be divided into several parts. Population trends must be known in order to select school-building sites before land areas in the district are developed. Residential saturation must be anticipated if the size of school buildings is to be determined in advance. School population totals must be known if the actual building construction program is to be satisfactorily carried out.

Each activity connected with the building program requires certain specific knowledge regarding the population. The information desired will not be the same in each case. Where gross population data will serve for the analysis of trends in area developments, specific school population information by grade groups must be known for site selection and for planning the building units to be constructed.

Other agencies have found it essential to gather information concerning population changes in the development of their own enterprises. Their findings have been made available to estimate future school population. In the use of these forecasts, it has been assumed that the school population is an increment of the total population and that a consistent percentage relationship exists between them. The assumption holds in so far as the school census is concerned. The school census, however, is only a crude measure of potential school population. On the other hand, it is less true for the other measures of population, such as attendance or enrollment. There are many variables which modify the school population and which are not even remotely associated with total population.

Techniques Used in Forecasting Population

A number of methods have been used to forecast total population. These vary from the one extreme of mere guessing to the other of elaborate mathematical processes. With all the variables which cause population change, it is practically impossible to devise a method which will give results which can be validated. For this reason any forecasts must be used with caution.

Many mathematical methods for prognosticating population have been devised. They can be used only in cases where numbers are large and where data are available for a long period of years. When applied, they cannot be adjusted to situations where additional land areas have been acquired during the period studied. There is a distinct advantage in the mathematical methods in

that they provide a means for determining the inter-censal data from the curve developed.

A common practice used in many surveys has been based on the assumption that a curve can be drawn through a series of known datum points and then extended in the direction considered desirable by the observer. Forecasts as to trend and population totals are made from the extended graph. Such a procedure may be used to define roughly the possible limits within which change may be anticipated. The results in most cases where this practice has been followed are little better than guesses. Unless one can determine the mathematical law which underlies the relationship of the known data and unless the equation can be determined, there is no way of projecting the curve beyond the known, except by guess. There may be conditions which may justify the practice. Yet when the curve is extended in this manner, care should be exercised in the use of the data and in presenting them. It is so easy to give a false atmosphere of precision and validity to that which has the appearance of having been treated mathematically.

Population growth in a given area implies changes in the social and economic status of the people proportioned somewhat by the rate of increase. Variations in any of the factors modified by population change are not necessarily synchronized. Cause and effect are not related. The mere fact that this fundamental relationship exists has tempted many to assume that the ratio of economic change, expressed in certain of its manifestations, to the total population will remain approximately constant from year to year. It has been assumed that, if the rate of business and industrial expansion could be measured, the measuring unit might be applied directly to determine total population change and hence school population growth. There is little evidence to show that techniques based upon these assumptions are valid or give satisfactory population forecast results.

The analysis methods of forecasting population have, no doubt, the greatest possibilities. In this technique indices for all the elements which have to do with population change are calculated and the trend noted. Futures are determined by applying these indices to the known past facts. The use of this technique requires continued calculation and check in order to correct the indices, because of the changes which are constantly occurring. The Bell Telephone system has developed and used this technique in prognosticating telephone service needs.

Although investigations show that, as a rule, school population data for the past cannot be relied upon, it is believed that the improvement in record keeping and administrative practices will provide for the future data which will give an accurate estimate of the number of children for whom school authorities must make an accounting. School population facts are available yearly, monthly, and daily, if needed. If these data cannot be accurately recorded and if the resulting statistics are not reliable, then to resort to other sources for aid in forecasting school needs will be of little avail. Unless school authorities are able to predict school population change from the data of school records, there is little hope of anticipating success in this field.

Continuous Planning

The many variables which enter in to modify population and its needs, prevent forecasting with any degree of reliability for many years in advance. A general picture of the future can be fully conceived, but plans must be worked out for shorter periods. Anticipating the future requires constant vigilance, planning in advance in terms of known facts, and then checking, verifying, and modifying the program on the basis of new facts and actual occurrences. It is a mistake to attempt to forecast a building program for 25 years, except in its most general terms. It is doubtful whether a specific plan made for ten years in advance can be completed without some changes in the light of new developments. It would be mere chance if every detail of a plan projected for even this short period could be carried out unmodified.

School and City Planning

The growing complexity of city problems requires that school-building programs and city planning be developed together. Those responsible for the schools should be vitally interested in city planning and should be closely associated with every step taken. The schools are so closely related to the population they serve that failure to consider the educational significance of projected city plans will result in severe economic losses, as well as in a direct handicap to the schools.

Problems in School-Building Construction

BY J. W. McCLINTON

DIRECTOR, BETTER SCHOOLS LEAGUE, INC., CHICAGO, ILL.

WHEN does a community need a new school building?—How should it be financed?—How budget the available funds?—Where should the building be placed?—How should the architect be selected, and how gain the public support and approval for the program?—these are problems that enter into every building project. They hold equally true, whether for a single building in a small school district or an extensive building program in a more densely populated or rapidly growing city.

The survey is basic in business. The number of people passing a certain street corner location in a day may be a deciding factor in the location of a store. Commercial associations make surveys to determine whether there is buying power within a reasonable radius to warrant one, two, three or more stores selling the same line of goods. A manufacturing concern, before taking on new lines, will first determine by survey the public demand or probable market for these lines.

The survey, so extensively used in business, is more important in the planning for educational expansion in a community. It will assist in answering when and where the building. In business an error in production planning will eventually correct itself; in schoolhouse planning and placement, perhaps never.

When Does a Community Need a School Building?

There are four main conditions which will dictate a building project. The first is the rapidly growing community, carrying with it the increased school enrollment, demanding an expansion of school facilities. The second is the set type of community. Existing school plants have served the district for years, and now sanitation, health and safety conditions compel replacement. The third condition is rather unusual and yet has been brought to our attention in a number of instances. There exists no demand for additional space; in fact, the present school building affords more room than the constantly dwindling school attendance requires. The school plant, being antiquated, does not admit of modern methods in instruction. The community faces the necessity of bringing new life to the student body in an effort to effect a remedy for the yearly student casualty list, due to the absence of pupil interest. The fourth is the necessity for replacement because of destruction by fire, cyclone, etc. This fourth situation rarely furnishes much ground for division of sentiment.

Differences of opinion always exist as to whether old buildings should be replaced. "What was good enough for the parent is good enough for the child" still finds many supporters, not only in regard to curriculum content but also to physical equipment as well. The school-building score card in experienced hands should tell the story. A school building scoring 300 on the basis of 1,000 maximum would not seem physically fit to meet requirements.

How Finance the Building Project?

Two main schemes for financing are in common use—the "pay-as-you-go" and the bonding plan. The writer suggests a third, namely, the 50-50 plan.

Time was when regulations covering the establishment of a sinking-fund were not always observed. Some communities even found it necessary to issue refunding bonds. Fortunately, the schools fared better than other public improvements, because the life of the school improvement was greater. The fact still remains that we have school buildings throughout the country which should now be supplanted by better structures, and yet the communities are still carrying mortgages on the old ones! To remedy conditions, both in respect to schools and in respect to other public improvements, full-time bonds have been, for the most part, supplanted by serial bonds.

Legislation covering bonding in cities of the third class in the state of New Jersey, during the session of 1928, shows the general trend:

> "Bonds issued hereunder shall be made payable in annual installments, commencing not more than two years from their date of issue. . . ."
>
> "All bonds issued hereunder shall mature within a period not to exceed the following number of years, for the following classes of purposes:
>
> "(a) Of frame construction . . . twenty years
>
> "(b) Of non-fireproof construction . . . thirty years
>
> "(c) Of fireproof construction . . . forty years."

Communities having sufficient taxable property and resources to make the "pay-as-you-go" plan practicable are fortunate. Manifestly, it is impossible for all school districts and towns to carry on in this way. The burden of expense would be prohibitive, on the one hand, and to postpone building activities until such procedure would be feasible would result in much educational retardation.

The most significant practice which has come into school planning in recent years is the anticipation of future needs. Boards of education might well apply this forward-looking policy to school-building finance. It would seem good busi-

ness policy to set up a gradually increasing building fund—a cash reserve. The inauguration of such a policy years in advance of a building project would necessitate bonding for but a fraction of the required construction funds. The Board of Education would be approaching the 50-50 plan. If we build a home, we cannot reasonably expect a reputable agency to make a loan on the property for more than 50 per cent of the value. If we make a farm loan, we cannot expect the mortgage to exceed 50 per cent of the property value, and the general practice is 40 per cent. It would seem good business, therefore, to gradually get away from the policy of erecting a building and mortgaging the community for 100 per cent of the value of the improvements.

A number of the larger cities having adequate valuation are gradually changing from the bonding to the "pay-as-you-go" plan. Manifestly, it must be a slow and gradual change, so as to avoid immediate excessive tax burden. In the same manner the smaller school districts can gradually change from the straight bonding plan to one approaching the 50-50 plan. It should result in a more favorable school bond market; it will decrease the interest outlay, and will reduce school-building finance to a business basis.

How Budget the Available Funds?

Available statistical data show that on the average 20 per cent of the funds accrued from bonds go to the purchase of the building site, where such transaction takes place at the time the building project is undertaken. We hold that a building site should not be a part of the building budget. Sites should be secured several years in advance of the actual building needs. This policy will eliminate one of the greatest causes of variations and divisions of sentiment in a community during a building program—a time when there should be the greatest solidarity. Population trends are easily determined, and the problem of forecasting future school-building sites is not a difficult one. It is, however, an educational engineering problem calling for professional assistance and guidance.

Budgeting of the available building funds has, for the most part, not been practiced. The program is undertaken on an estimate for the completed job. A different form of the "pay-as-you-go" plan has been practiced in some cases to an almost criminal extreme: If the funds are insufficient for a completed job, then pay for the building and omit items that remain, regardless of the extent to which it hampers the school program! If funds run short, omit the time-clock systems and cleaning equipment; consider the heating and ventilating in light of the cost of the system and not in terms of health of the child! Install old equipment and be wholly indifferent to the new and modern furniture! Cut down on or eliminate ground landscaping and playground equipment! On dedication day, emphasize the structure and ignore the furnishings! Extol the monument to the community's educational advancement, but conceal the lack of soul and heart, the motivating influences which it is supposed to house!

The picture may seem overdrawn, but it is too true to the actual practice. Statistical data covering 350 cities having erected buildings within the last five-year period show that 22 per cent of the school districts so carried on. Mortar and brick and steel and cement do not make a school, any more than counters and desks and walls and vaults make a bank or building and pews make a church.

The following table, based upon practice in 350 cities, gives the pro rata of funds necessary for building and equipment:

Buildings Housing	*Percentage of Building Fund for Equipment*	*Percentage of Building Fund for Building*
Grades 1–6	8.2	91.8
" 1–8	10.0	90.0
" 1–9	13.6	86.4
" 1–12	14.0	86.0
" 7–9	10.0	90.0
" 7–12	12.2	87.8
" 9–12	15.0	85.0
" 10–12	16.6	83.4

Various methods have been used as a basis for computing school construction costs, such as cost per cubic foot, cost per pupil capacity, cost per square foot floor space, per room cost, etc., etc. None of these are reliable, since school buildings have not been standardized as to construction material or special features to be included.

The services of the school architect, who should be under temporary contract at this stage, are essential in computing the approximate amount needed for the building project.

Where Should the Building be Placed?

There are certain negative and positive considerations. The negative influences are too close proximity to street-car tracks, railroad intersections, disturbing noises, unhealthful conditions and immoral hazards. The positive considerations are centers of pupil populations and means of transportation.

If the building project is in a populated community, building placements should avoid overlapping of territory, on the one hand, and extreme distances which pupils must travel, on the other. In the latter case, the maximum distance for elementary school children is generally placed at one-half mile, necessitating buildings at mile intervals; junior high school students, a mile, placing buildings at intervals of two miles; high school students, a mile and a half, thus placing buildings at intervals of three miles. In the case of the high school, a larger area may be served by a single building unit where transportation facilities are available. In comparatively undeveloped districts, home construction, telephone installations, sewer and water connections, electric light development, appearance or position of industrial sections, parks, cemeteries, business centers, apartment sections, subdivisions, lines of transportation and pro-

posed extensions, census growth and school population growths are controlling factors.

It is evident that the selection of school-building sites or building placement is dependent upon the survey and lends itself to a solution by scientific investigation.

Selecting the School Architect

The smaller community is usually strong for a local architect. This requirement seemingly outweighs any qualification said architect may have as a school-planner. Frequently the writer has been asked to assist the superintendent in the dilemma where a local architect, inexperienced in school planning, must be employed. If the term "must" is unchangeable, then there is but one solution, the employment also of a consulting architect—a school specialist. The second situation is where the board of education insists upon a "free for all." Such a plan is as unfair to the architect as it is to the public whom the board of education represents. A board of education cannot expect a group of professional architects to give adequate thought and sufficient preliminary sketching in competition on the ordinary school contract. As business men, accustomed to competitive bidding, the members of the board of education may not appreciate that there is a difference. A contractor submits an estimate on a job and practically every item is standardized. The formula applies, the prices of material and labor are available, etc., etc. On the other hand, the architect's planning is creative. It will not work according to formula—the project must have individuality and personality.

Two plans remain: One is the selection of a limited group of school architects who are called upon to submit competitive plans, with the stipulation that each shall be paid a definite remuneration. This system will insure a better group of architects. They will give value received, and the board of education will be the gainer by the better-thought-out-and-prepared preliminary sketches. On the basis of these sketches the permanent contract will be awarded.

The important question at this point is the competency for judging the preliminary plans submitted. Which plan will produce a building most closely approaching hundred per cent usage? What is the past record of the various architects on extras? Certainly, a board of education inexperienced in school-building programs will require professional assistance in evaluating the various plans submitted.

The writer is inclined to go one step further and eliminate competitive plans entirely. It is recommended that the board of education, after investigation, select a school architect and employ him for the preliminary sketching. The temporary contract does not become permanent until such time as satisfactory plans have been submitted and approved. The fee for the preliminary work should be treated as part payment in the permanent contract.

When the architect or firm employed cannot furnish the board of education educational engineering service, it is important that the latter secure such service in order that the board, the architect and the educational engineer may produce a building as closely approximating a hundred per cent usage as possible.

How Gain Public Approval for the Building Project?

There has been no greater development in the handling of the school-building problem than the publicity plans employed to sell the program to the public. This has probably resulted from necessity. This necessity is the outgrowth of a more discriminating public mind, on the one hand, and, on the other, the rapidly developing school enrollment, necessitating frequent building projects or a large program extending over a period of years. It has been the contention of the writer that where a regular publicity program has been carried on in a school system during the non-building years, the people are so well acquainted with the plans and purposes of the school officials that it will materially simplify the building campaign. It becomes a system of gradual education as a substitute for the cramming process.

Recent experiences have demonstrated the importance of lay participation in such projects. A bond issue of large denomination failed of public approval during the spring election in a characteristically American city with a high level of culture and education. There seemed to be no question on the part of the citizens that school expansion was essential; there seemed no reluctance to bear the additional tax burden; there did seem to be a distinct difference of opinion between the school officials and the majority of the voters of the community as to the best program to project. Had the Board of Education sensed this condition and called in a representative committee from the community to act in an advisory capacity, the results would probably have been different. The plan of the Board of Education was not acceptable to the citizens, and therefore a new one will have to be approved. It were better that the compromise plan be the original one.

A second observation has shown the greatest fatality in school bond election results in the smaller communities. This is doubtless due to the fact that lay leadership is lacking in these communities and the board finds it difficult to effect a tie-up in its campaign. The most successful campaign is the one calling into active participation the greatest number of outside interests.

Members of the board of education, as representatives of the people, are entrusted with the conduct of the schools. They, in turn, must delegate that power to the school executive. It is a wise administrator who appreciates his responsibility to the people, and who takes them into his confidence in all school planning, even to the extent of lay advisory participation.

THE HIGHLAND JUNIOR HIGH SCHOOL, LOUISVILLE, KY.

Louisville's New System of Junior High Schools

BY J. MEYRICK COLLEY

ARCHITECT, BOARD OF EDUCATION, LOUISVILLE, KY.

THE Board of Education at Louisville, Ky., is at present engaged in the erection of a system of junior high schools in which it is planned to provide junior high school instruction for every child in the city of the seventh, eighth and ninth grades, and will include buildings for both white and colored children. The accompanying plans and photographs are of one of the buildings which is typical of the entire group.

In adopting the complete system of junior high schools, our Board of Education has profited in both an educational and a practical way. The schools of Louisville were, like the schools of most cities at the present time, in a very crowded condition. The educational profit was in providing the modern junior high school type of instruction for all children, and the physical profit was in being enabled to put our money into new buildings and thereby relieve the congestion in both the graded and the high schools without the necessity of building a large number of small additions.

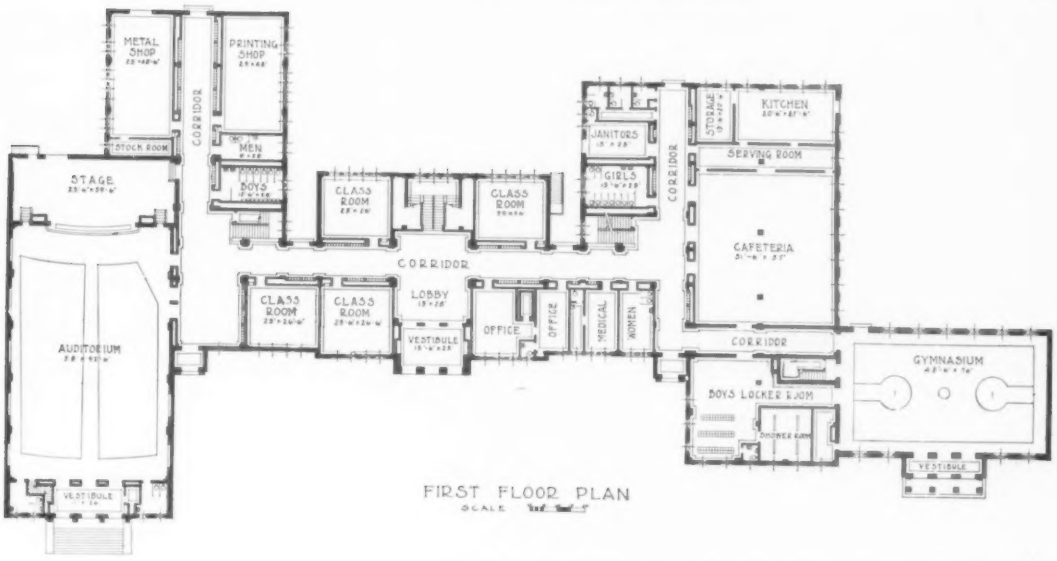
In the developing of the plans for these schools, first consideration was of course given to the producing of a highly efficient junior high school. Detailed study was given to the various features of the building, such as orientation, lighting, flexibility, administration and instruction. The latest and most modern schools in various parts of the country were visited and studied, and details and suggestions were gathered to incorporate in our own buildings.

School Buildings as Community Centers

During the planning of this system of schools, much time was given to a discussion of the modern tendency toward the use of school buildings as community centers. This thought was borne in mind in the location of the various units, as well as in the planning of individual buildings. The junior high school seems particularly well adapted to this idea and is easily the most logical unit for community use; this, partly because of the age of the children attending, partly because of the type of the building and equipment, and also from the fact that the travel distance to these schools is never very great. With these points in mind, and believing that the future will see even more of such use of the schools, we endeavored to arrange certain units of the buildings to best meet anticipated conditions.

There are two distinct forces working toward the increased use of school buildings for community events. In one instance the citizens themselves or, as they are more familiarly called, the taxpayers, are becoming more and more cognizant of the fact that they have a great deal of money invested in plants which are lying idle perhaps 75 per cent of the time. Again, the progressive men in the educational field are encouraging this use so that the schools may become a larger factor in the life of the community and may contribute more to general education. In planning our buildings it was found that the solution of the various problems in connection with community use actually worked out advantageously to the school itself.

The accompanying plans of the Highland Junior High School furnish examples of most of the dual requirements. There are two distinct types of activities which will be carried on in the school buildings. The first type will be in the nature of amateur plays, recitals, lectures and educational films, the second will be athletic contests, dances, civic club suppers and similar activities.



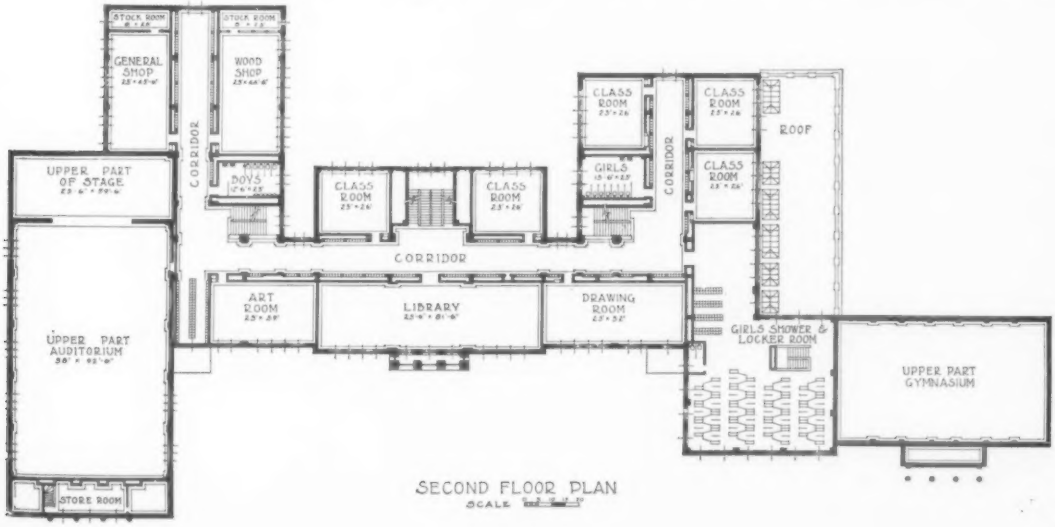
GYMNASIUM, SHOWERS AND CAFETERIA MAKE A COMPLETE UNIT ON THE FIRST FLOOR OF THE HIGHLAND JUNIOR HIGH SCHOOL, LOUISVILLE

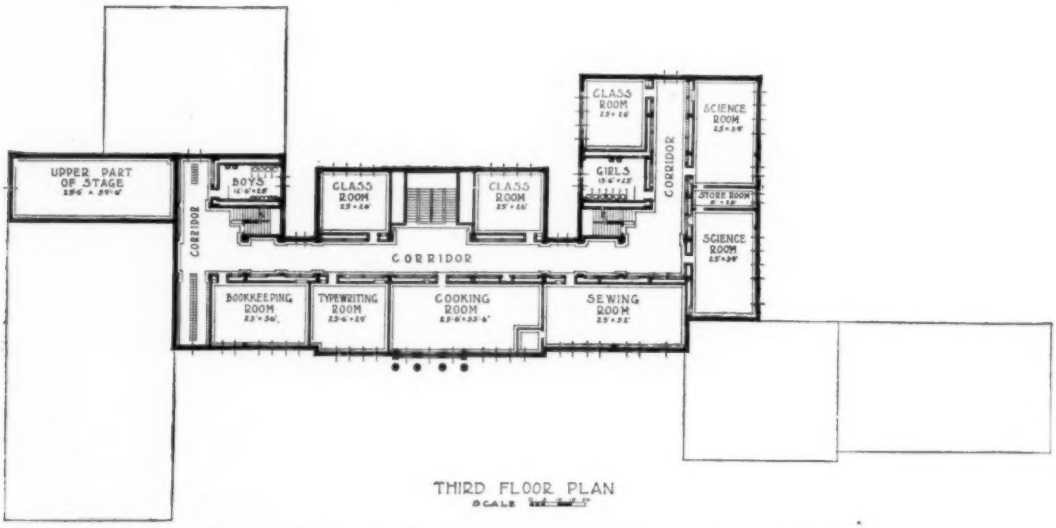
Auditorium, Gymnasium and Cafeteria

The auditorium and gymnasium units are the only portions that would be used for events the nature of which would necessitate special consideration in the plan. These units were therefore arranged so that they could be used without interfering with the school during school hours and without using any other portion of the building after school hours. It is not expected that there will be very much use of these units during school hours.

It will be seen by examining the plans, that the auditorium is provided with main entrance, stage entrance, scenery loading door, ticket booth, toilets, etc., separate and distinct from the instruction portion of the building. All lights are controlled from the stage or lobby, and the room may be heated and ventilated independently of the remainder of the building. The stage is equipped with a very modern type of stage lighting, including footlights, borders and spots. All of these, and also the auditorium lights, are controlled by dimmers from the stage, and, in fact, the auditorium with its equipment practically constitutes a small community-owned theater.

In the gymnasium unit at the opposite end of the building the same principles of planning have been carried out as regards the keeping of the unit separate from the major portion of the building. Owing to the fact that a different type of activity will be carried on in this portion, some-





THE THIRD FLOOR ROOMS GIVE SPECIAL VOCATIONAL TRAINING

what different problems were involved and had to be handled in a different way.

The probability of the serving of lunches at many of these entertainments necessitates the close proximity of the cafeteria. This arrangement will give a complete unit of gymnasium, boys' and girls' showers, and cafeteria, capable of being used without interfering with the remainder of the building.

When the use of the building progresses to the extent of such minor activities as small orchestras, technical and research societies and similar organizations, it will be found that the situation has developed into a system of extension courses and the major portion of the building will have to be opened as a school. As the pendulum swings once more and the problem changes from an empty building to a full one, the advantage achieved by the flexible arrangement of the auditorium and gymnasium will be more pronounced than ever.

The Louisville schools are not at present being used to the extent that the above discussion would seem to indicate, but their use in this connection is becoming rapidly more noticeable and we have endeavored to incorporate these various ideas in the new buildings in order to meet the problems which we believe will confront the school authorities to an increasing extent as time goes on.

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Auditorium Seats and Classroom Furniture—American Seating Co.
Boilers—Henry Vogt Machine Co.
Clocks and Signal Systems—Landis Engineering and Mfg. Co.
Drinking Fountains, Plumbing and Sanitary Equipment—Standard Sanitary Mfg. Co.
Heat Regulating System—Johnson Service Co.
Insulation—The Celotex Co.
Laboratory, Library and Office Equipment—R. O. Rosen Co.
Lockers—Lyon Metal Products, Inc.
Woodworking Equipment—E. H. Sheldon & Co.

The Unusual School System of a Suburban Community

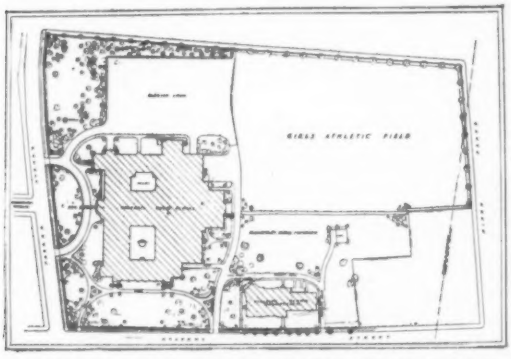
BY JAMES O. BETELLE

OF THE FIRM OF GUILBERT & BETELLE, ARCHITECTS, NEWARK, N. J.

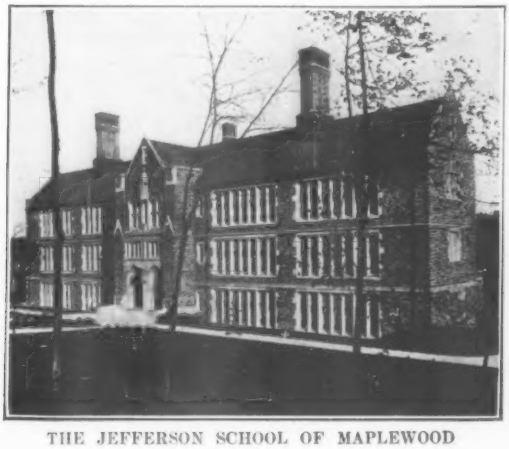
THE village of South Orange and the township of Maplewood, N. J., are two separate municipalities, which are entirely independent of each other, but the direction of whose educational affairs is vested in a single Board of Education.

These towns are fast-growing communities, within commuting distance of metropolitan New York. Their school population has doubled within the last eight years and will probably double again in another eight years. These communities are typical American suburban villages, with a very high type of citizenship. Most of the heads of the households are business men who commute daily to their offices in New York or Newark. A large percentage of the citizens of South Orange and Maplewood have sufficient means to send their children to private schools if they desire, but they have felt it better and more democratic to build good free public schools, and the illustrations accompanying this article show the type of buildings erected and the facilities provided.

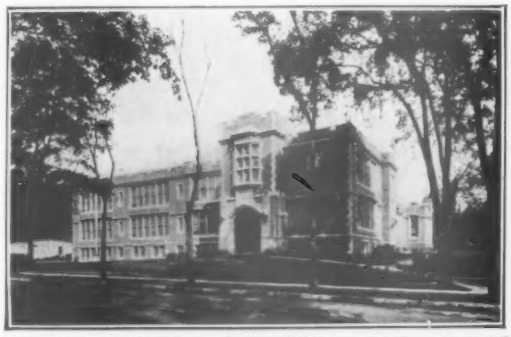
No private school in a community such as we are discussing can pretend to compete with public



COLUMBIA HIGH SCHOOL GROUND PLAN, SOUTH ORANGE AND MAPLEWOOD, N. J.



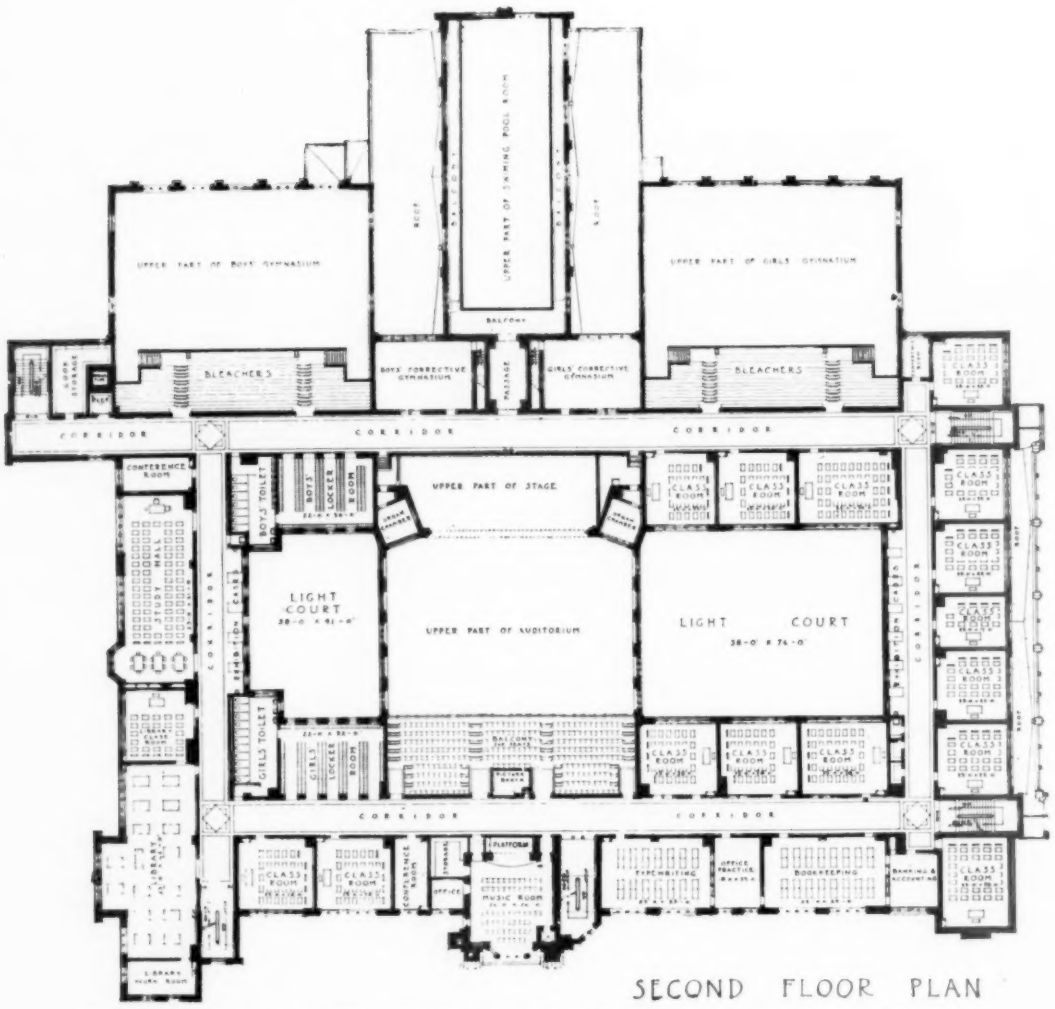
THE JEFFERSON SCHOOL OF MAPLEWOOD



MONTROSE SCHOOL (SIXTH GRADE), SOUTH ORANGE

VIEW OF MARSHALL SCHOOL, SOUTH ORANGE, FROM RAYMOND AVENUE

TUSCAN SCHOOL (SIXTH GRADE), MAPLEWOOD



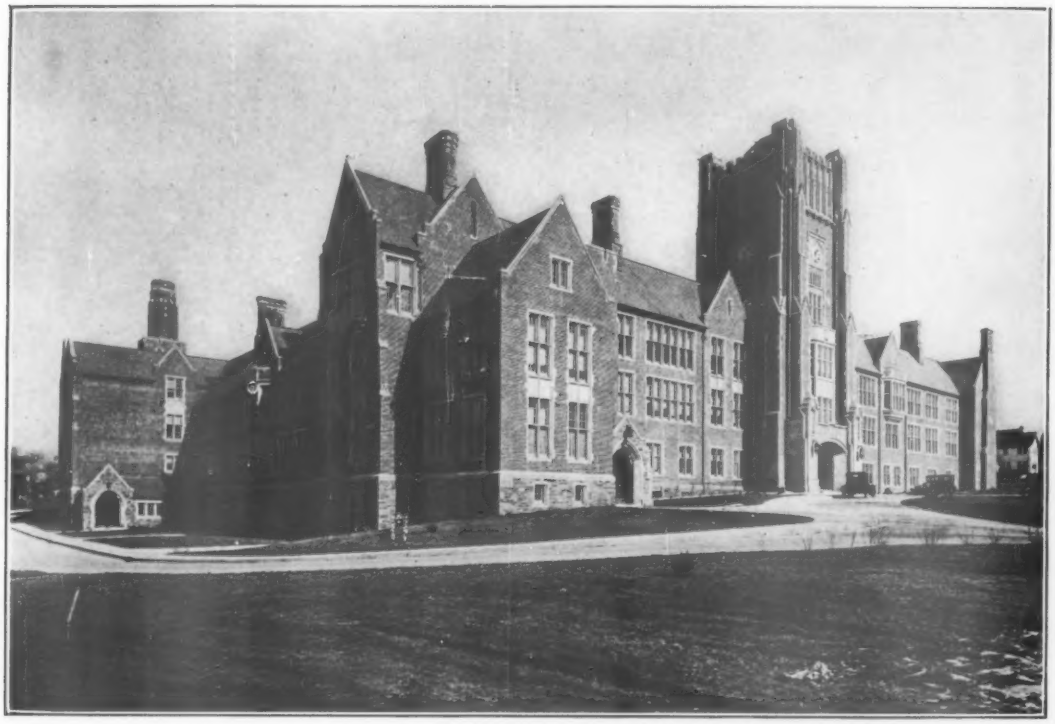
SECOND FLOOR PLAN OF THE COLUMBIA HIGH SCHOOL, SOUTH ORANGE AND MAPLEWOOD

Other features of the building are as follows:

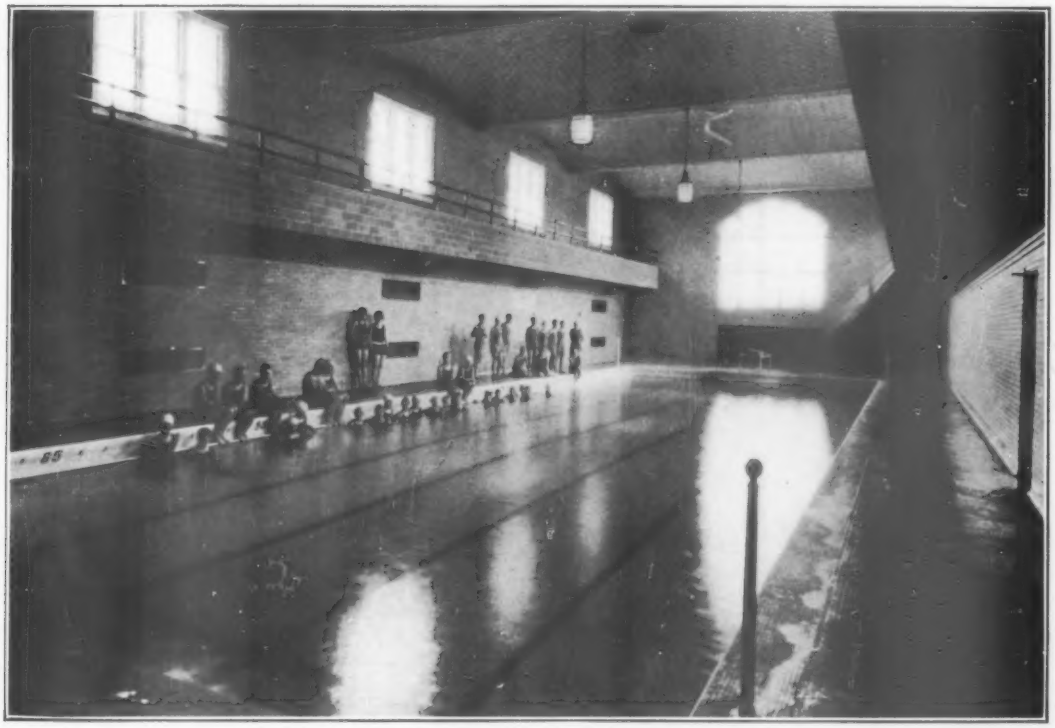
Basement—Swimming pool, plenum chamber, light court, pipe gallery, boiler-room, coal storage, fan room, engineer's room, unpacking room, toilet, corridor, janitor's room, lunch room, kitchen, dish-washing room, office, teachers' lunch room, girls' and boys' bicycle rooms, storage space, meter room, and transformer room.

First floor—Auditorum; domestic science section (sewing-room with fitting-room, dining-room, storeroom and office); principal's office; clerical office with waiting space, closets, and vault; secretary's office; girls' and boys' toilet and locker rooms; stage (part of auditorium) with dressing-rooms; doctor's, nurses', and dentist's rooms; boys' and girls' gymnasium; manual training room; automobile shop; light courts (2); study hall; class rooms (3); business office; bookkeeper's room; stenographers' room; superintendent's office; board room; teachers' rooms; swimming pool room with lockers and showers; distributing rooms, and laundry.

Third floor—Light courts (2); roof over auditorium; rooms for mechanical drawing, and crafts; laboratory rooms for chemistry, biology, physics; lecture room; classrooms (9), book storage, conference rooms, preparation rooms and dark room for science departments, upper part of stage and organ motor room.



COLUMBIA HIGH SCHOOL, DISTRICT OF SOUTH ORANGE AND MAPLEWOOD



SWIMMING POOL OF THE COLUMBIA HIGH SCHOOL

schools, either in the facilities provided or in the quality of teaching, for the very good reason that a private enterprise has not the capital which is made available by the many property holders in a wealthy suburban community. So it resolves itself into the question, why should a citizen pay tuition to a private school when there is a public school which his taxes help to support and which his children can attend without cost?

School System on a Junior High School Basis

The school system has been recently reorganized and placed upon a junior high school basis; that is, there are a number of six-grade schools, there will be several junior high schools when the organization is entirely completed, and just recently the new Columbia Senior High School was finished and occupied.

The grade schools are strictly community schools where no child lives more than about a hali-mile from the school site. All of these grade schools contain about the same facilities; that is, the standard classrooms, an attractive kindergarten, an auditorium, and gymnasium.

It has been the endeavor of the Board of Educaiton to build these schools in such a way that they will be an improvement to the neighborhood rather than a detriment. Such were the instruetions given to Messrs. Guilbert & Betelle, the architects for all these new buildings. The successful results are shown by the accompanying photographs and by the increased valuation of neighboring property and the fine houses built around the new schools. As far as possible each school has been made to harmonize with its neighborhood; for instance, the school built of stone is located on the side of the Orange Mountain, where there are numerous quarries of the stone from which the school has been built. The citizens have responded in a very excellent way to these fine types of schools, so that they are now not only proud of the school system but are back of it in every way.

The New Columbia High School

With the erection of the new Columbia High School, which is located in the geographical and population center of the two communities, the building program reached its highest expression, and there are few schools in the country of its size that contain a greater number of such fine educational facilities.

As indicated by the plans, the standard classrooms are supplemented by rooms for special subjects, all of which are liberal in size for their purpose, as it has been found that as a rule these special rooms are crowded when furniture has been installed. The auditorium, in the center of the building, seats 1,300 persons, and incorporated in the large stage is a handsome pipe organ.

The boys and girls have been treated equally as far as gymnasium accommodations are concerned, each having a full-size gymnasium, with permanent concrete bleachers across one side. Between the two gymnasiums has been located a tile-lined swimming pool, with a spectators' gallery above and around it. The tank proper is 25 feet wide and 75 feet long. Between the swimming pool and the gymnasiums are the boys' and girls' locker-rooms, so they serve both the gymnasiums and the swimming pool at the same time.

The materials used throughout the building have been selected with care, and with a view of being substantial yet simple, and suitable for the hard usage to which a school building is subjected. The exterior of the building is in the Gothic Collegiate style, of red brick with limestone trim and a variegated slate roof, and is fireproof throughout.

On top of the central entrance tower has been built an astronomical observatory to accommodate a telescope which has been presented to the school. Directly beneath the observatory is a classroom or conference room to be used in connection therewith. As it is anticipated that this observatory will be used by some of the study clubs of the community, an elevator has been run from the vestibule of the main entrance tower to the roof, to avoid the tiresome climbing of stairs.

Athletic and Parking Facilities

The building has been located on a large plot of ground, and the girls' athletic field is in the rear. The boys have a large athletic and football field in another part of the town. Special consideration was given to parking facilities on the property, and a very large area, paved with concrete, has been provided for this purpose, as the parking of automobiles is becoming more and more of a problem, not only during the day sessions, but more particularly during entertainments given in the auditorium in the evening. This parking space has been brilliantly illuminated and will be policed when the number of parked automobiles makes it advisable.

The building has a maximum pupil capacity of 1,630 pupils. It contains 2,860,000 cubic feet, and cost $1,500,000, exclusive of land and equipment.

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Art, Laboratory and Shop Equipment—E. H. Sheldon & Co.
Auditorium Seats—Steel Furniture Co.
Blackboards—Knickerbocker Slate Co.
Boilers—Kewanee Boiler Co.
Classroom Furniture—Heywood-Wakefield Co.
Clocks and Signal Systems—Howard Clock Co.
Drinking Fountains—The Halsey W. Taylor Co.
Fire Alarms—Stanley & Patterson, Inc.
Flooring Materials—Bonded Floors Co., Inc.
Gymnasium Equipment—A. G. Spalding & Bros.
Heating and Ventilating System—Peerless Unit Ventilation Co., Inc.
Heat Regulating System—Powers Regulator Co.
Insulation—Johns-Manville, Inc.
Lighting Globes and Fixtures—Westinghouse Electric and Mfg. Co.
Lockers—Durabilt Locker Co.
Office Equipment—The Van Dorn Iron Works Co.
Plumbing and Sanitary Equipment—James B. Clow & Sons.
Projecting Equipment for Moving Pictures—International Projector Corp.
Refrigeration Equipment—Frigidaire Corp.
Swimming Pool Equipment—Wm. B. Scaife & Sons, American Steam Pump Co., Wallace & Tiernan Co., Inc.
Window Shades—Stewart Hartshorn Co.
Woodworking Machinery—Oliver Machinery Co.

CHEMISTRY LABORATORY, COLUMBIA HIGH SCHOOL

MANUAL TRAINING SHOP OF THE COLUMBIA HIGH SCHOOL

George Inness Junior High School, Montclair

BY STARRETT & VAN VLECK

ARCHITECTS, NEW YORK

THE George Inness Junior High School in Montclair, N. J., completed in the fall of 1927, is one of a group of three educational buildings located in fairly close proximity to each other. The Senior High School, diagonally across the street, with the Garden Open-Air Theater directly opposite the George Inness School, and the Rand Elementary School a short block away, are the other two members of the group. All these buildings have been designed on Colonial lines with Harvard brick exterior walls and limestone or cast stone trim.

The George Inness Junior High School is a building of the "H" type of plan, with a centralized auditorium at the rear and two gymnasiums on the front carried directly up into the pitched roofs. The building is so planned as to admit of extensions to the rear on both wings. The library is in a centralized position on the second floor, directly over the main entrance.

The administration rooms have been grouped at the front of the building in a centralized position and are so planned that no changes will be necessary when the wings of the building are extended and the pupil capacity greatly increased. This administration suite, as shown in the accompanying floor plan, is unusually complete.

The auditorium, while small and seating only 700, is very completely equipped for dramatic work. Over the stage is a regular steel gridiron for scenery support.

A standard size motion-picture booth is located in the rear of the balcony.

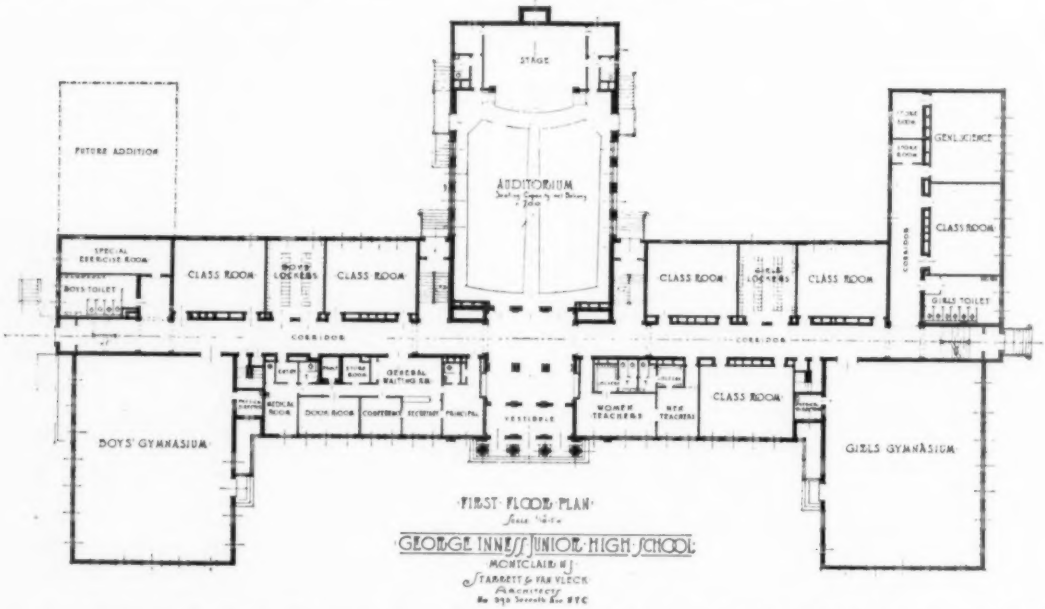
Pupils' clothing is cared for by the alcove locker system at four central points with metal lockers in well-lighted and ventilated alcoves.

For the display of students' work, trophies, etc., specially designed display alcoves with glass doors have been designed, located in the main lobby of the first floor and in the corridor walls of the second floor in a centralized position.

The corridors are wainscoted with salt-glazed buff brick, with the floors of terrazzo in pattern. Terrazzo is also used for toilet floors. The interior trim throughout the building is of ash, and the floors generally are of maple. Plate glass has been used for all exterior windows and glazed panels in doors.

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Boilers—Kewanee Boiler Co.
Clocks and Signal Systems—Standard Electric Time Co.
Drinking Fountains and Plumbing Fixtures—The Halsey W. Taylor Co.
Fire Alarms—Holtzer-Cabot Electric Co.
Heat Regulating System—Johnson Service Co.
Lighting Globes and Fixtures—MacBeth-Evans Glass Co.
Sanitary Equipment—Crane Co.

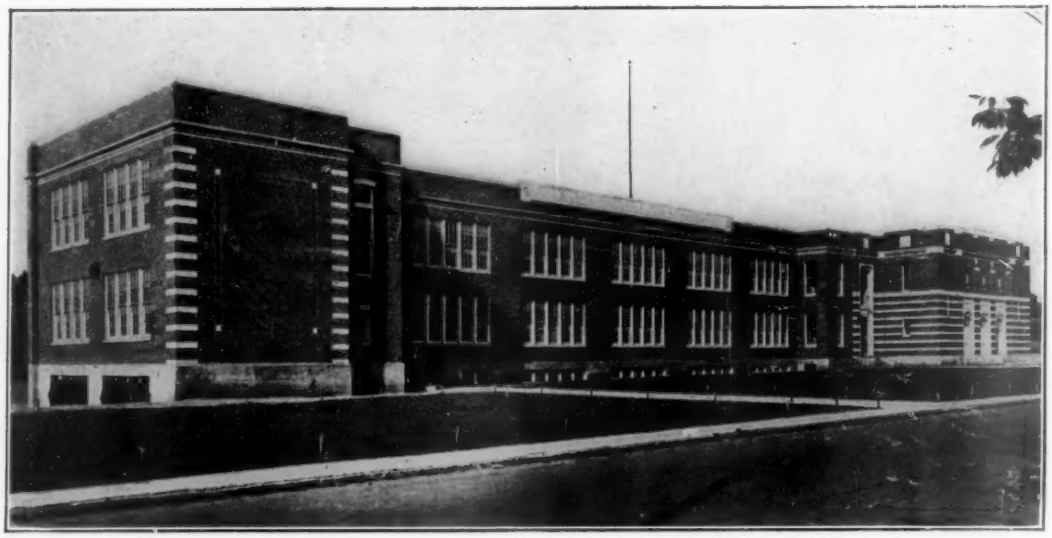


In the basement of the George Inness Junior High School of Montclair, N. J., besides the usual rooms connected with heating, lighting and storage, toilets and lockers, there are a print shop, a domestic science room, with dining-room, living-room, bedroom, and bathroom; kitchen and lunch room; sewing-room, fitting-room, etc.

The second floor contains the upper parts of the auditorium, a stage and two gymnasiums; a special exercise room, teachers' conference rooms, music room, library, commercial room, art room, and classrooms. Adjoining the music room there is an instrument room which has a display window opening on the corridor.

THE PLEASING SETTING OF THE SCHOOL

LIBRARY OF THE SCHOOL



Piedmont Junior High School, Charlotte, N. C.

BY ARTHUR HILL

CHARLOTTE OFFICE, LOCKWOOD GREENE ENGINEERS, INCORPORATED

THE Piedmont Junior High School at Charlotte, N. C., is regarded as an excellent example of modern school design. The structure is of reinforced concrete frame, three stories and basement, with provision for future extension. Exterior treatment has been carried out with face brick trimmed with limestone. The setting is such as to bring out the architectural features.

The interior arrangement of rooms has been laid out in a most compact form; this applies particularly to special rooms, such as general science and biology laboratories, sewing rooms, cafeteria, and cafeteria kitchen; general offices, and the office of the Superintendent of School.

The building contains fifteen general classrooms, 23 x 26 feet, with a ceiling height of 12 feet, and accommodating about 35 students each. These classrooms are so arranged around the building that each classroom touches an outer wall, so as to receive maximum daylight from the windows.

The auditorium is located on the right wing of the building, with seating capacity of 1,030 people, and is comprised of a main floor and balcony. The stage is of ample size to take care of present-day student productions, and has sufficient dressing-rooms immediately off-stage to prevent overcrowded conditions. Modern stage equipment has been included, such as foot and border lights, curtains, side and back drops.

A moving-picture booth has been incorporated at the center rear of the balcony with sufficient equipment to display pictures and to furnish spotlights for the stage. Air changes are taken care of by series of exhaust fans located on the roof.

The cafeteria is located in the basement of the building, and is 40 x 66 feet, sufficient size to accommodate 300 pupils at one time. The adjoining kitchen, 22 x 22 feet, embodies practically every detail necessary for a room of its character, such as coal range, gas stove, refrigerator, dish washers, drying machines, and steam tables.

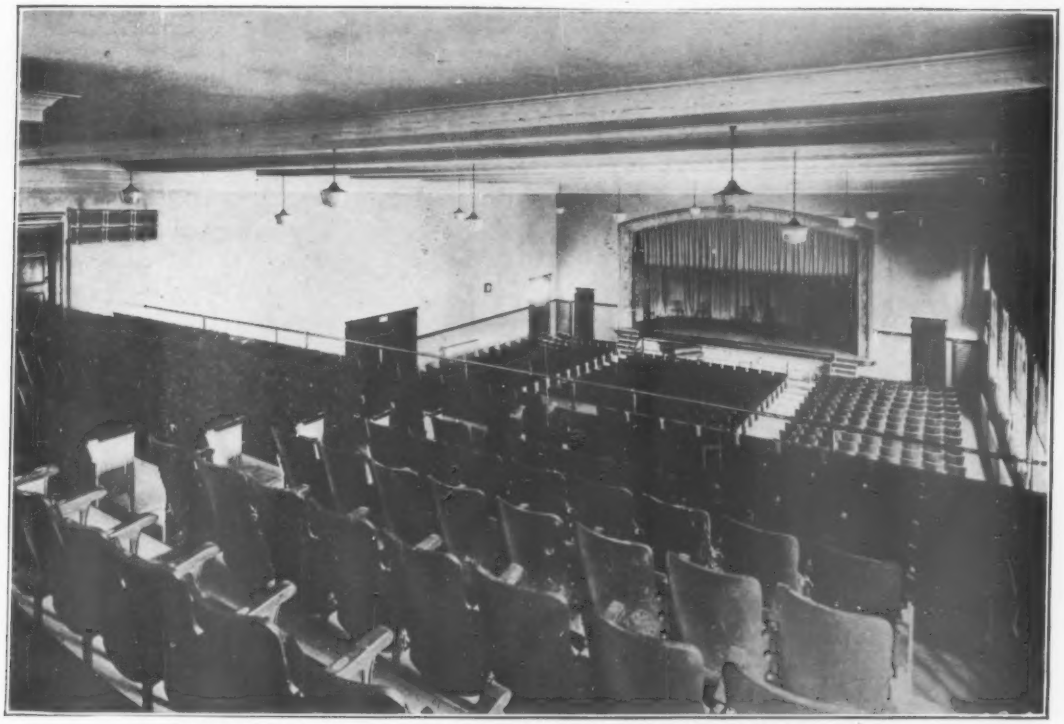
The manual training department, also in the basement, is in a room 80 x 22 feet fully equipped with lathes, planers, band saws, cut-off saws, tables, work benches, and sufficient incidental tools to turn out finished cabinet work.

The domestic science department is located on the first floor in a room 45 x 22 feet and contains among its equipment a miniature kitchen, with gas stove, refrigerator, kitchen cabinets, tables and gas plates.

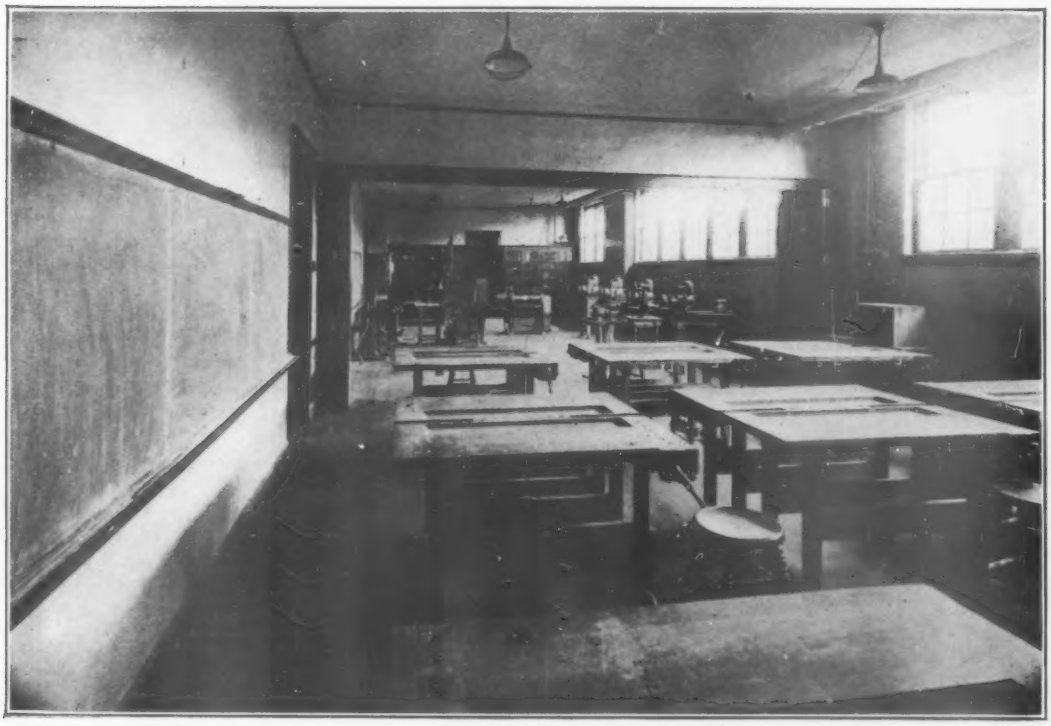
The biology laboratory is located on the third floor in a room 45 x 22 feet. This room is also fully equipped and is so arranged that it accommodates twelve working tables, with an individual sink and water and gas connections at each table.

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Art and Library Equipment—Leonard Peterson & Co.
Auditorium Seats and Classroom Furniture—General Seating Co.
Blackboards—Natural Slate Blackboard Co.
Boilers—Pacific Steel Boiler Corp. of Ill.
Cafeteria Equipment—Hutchinson Bros.
Clocks and Signal Systems and Fire Alarms—Standard Electric Time Co.
Drinking Fountains, Plumbing and Sanitary Equipment—John Douglas Co.
Heat Regulating System—Johnson Service Co.
Laboratory Equipment—Kewaunee Mfg. Co.
Lighting Globes and Fixtures—Graybar Electric Co.
Lockers—Berger Mfg. Co.
Shop Equipment—Oliver Machinery Co.
Windows and Sash—Austral Window Co.



AUDITORIUM OF THE PIEDMONT JUNIOR HIGH SCHOOL, CHARLOTTE, N. C.



MANUAL TRAINING ROOM OF THE SCHOOL

Three Basic Considerations Which Determined the Design of a Tampa High School

BY FRANKLIN O. ADAMS

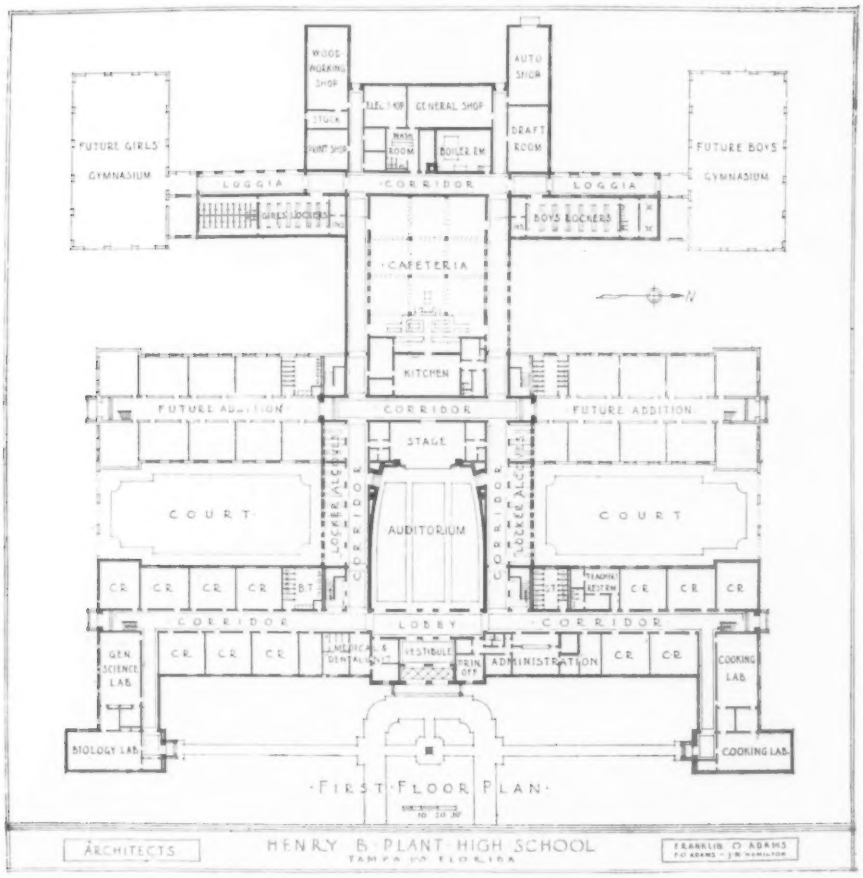
ARCHITECT, TAMPA, FLA.

THE Henry B. Plant High School at Tampa, Fla., was completed as part of a school-building program covering a period of about three years and costing approximately $3,500,000, the whole being based on recommendations conveyed in a general school survey of the Tampa district, made by Drs. Strayer and Engelhardt of Columbia College, New York. It was the second largest project of the program, costing $384,500, or 22½ cents per cubic foot (exclusive of lighting fixtures and furnishings), and was intended to serve a large and rapidly growing community, the population of which will probably treble in a few years at the present rate of growth.

A plot of 20 acres was secured as a site by the school authorities, and the general space requirements of the building were outlined by the authors of the survey, who likewise served in an advisory capacity to the school trustees. The site is the shape of a truncated right-angled triangle and is approximately level. A high subsurface water-level rendered a basement impractical, though an extensive drainage system insures a dry grade surface.

At the time the first studies were made, three conditions established themselves as being basically important. The first of these was the establishment of a proper relationship between the uses of certain allocated spaces and their location in the plan, affecting such questions as objectionable odors and noises, frequency of use, and directness of communication. Places of general assembly, such as the cafeteria and assembly hall, were placed in the center of the scheme, the latter be-

THE HENRY B. PLANT HIGH SCHOOL, TAMPA, FLA.



ing located toward the front so that the main entrance to the building is also the main entrance to the hall, and immediately adjacent thereto. General classrooms, including those in the proposed future additions, representing the densest population of the building, are in two stories radiating from this assembly center, with direct communication thereto. Those units, such as shops, gymnasium, kitchen, laboratories, music studio, typing and bookkeeping departments, and domestic arts, which by nature of their use represent disturbing elements and which are used less frequently, are pushed to the outer edges of the plan and thus partially segregated, their positions with relation to each other and to the general center being given careful study by the architect of the building.

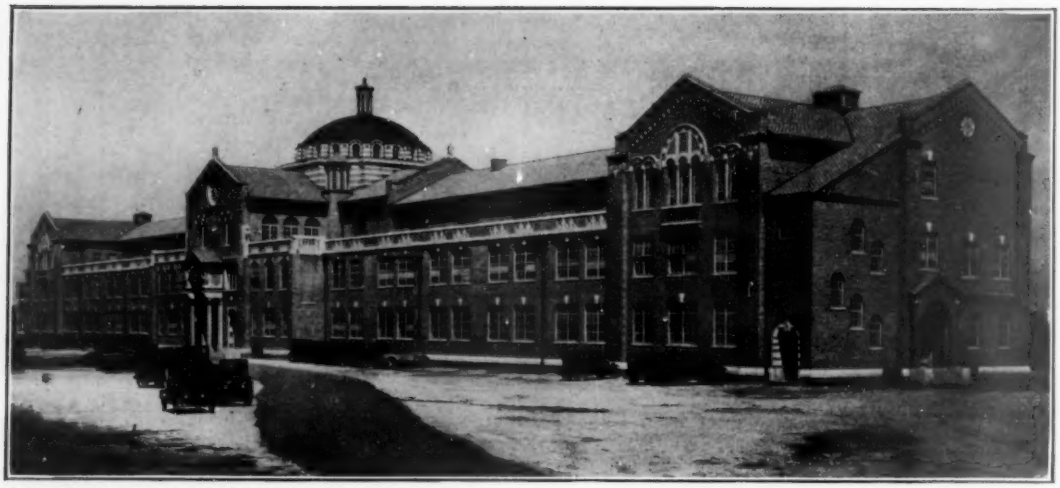
The second important consideration was the location of future additions that would not disrupt the established scheme but would rather complete it; that would provide for trebling the general classroom population in two separate building stages; and that would permit of future building at a minimum of cost. The result was the placing of these proposed additions as indicated on the plan.

The third basic consideration was that imposed by the sub-tropical climate of south Florida, indicating the open rather than closed or compacted type of plan, the open courts of the first-named type catching the passing air currents and diverting them through the windows of the classrooms, from which breeze windows in the corridor walls permit their passage to corridors and other classrooms beyond.

The design of the building has been treated with simplicity, frankness and dignity, using mass and window grouping for composition; further interest was secured on the exterior by a careful selection of the color and texture of the brick and stone, and the use of a limited amount of ornament thoughtfully placed.

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Art Equipment—Kewaunee Mfg. Co.
Auditorium Seats—Theodor Kundtz Co.
Blackboards—Natural Slate Blackboard Co.
Cafeteria Equipment—Albert Pick & Co.
Clocks and Signal Systems—International Time Recording Co.
Fire Alarms—Standard Electric Time Co.
General Science Laboratory Equipment—E. H. Sheldon & Co.
Chemical Laboratory Equipment—W. M. Welch Scientific Co., Central Scientific Co.
Library Equipment—Leonard Peterson & Co.
Lockers—Lyon Metal Products, Inc.
Printing Shop Equipment—American Type Founders Co.



Edwards & Sayward, Architects

The Girls Senior High School, Atlanta, Georgia

BY WILLIAM J. SAYWARD

ARCHITECT, ATLANTA; SECOND VICE-PRESIDENT, AMERICAN INSTITUTE OF ARCHITECTS

IN designing the building for the Girls Senior High School in Atlanta, a very unusual problem was presented by reason of the site. This was upon a tract of some thirty acres with wide variations in elevation. The high area was of comparatively small dimensions, located at one side of the tract, fortunately at the head of a street, and took the form of a triangular-shaped promontory jutting out precipitously over a valley of 96 feet. This explains the unusual grouping indicated upon the plans.

The capacity of 2,500 pupils was established as the ultimate maximum and it was considered desirable to arrange the buildings in units, allowing their successive erection as requirements might dictate. The first or main unit has been built, and on account of its being the only unit for some years, it was necessary to incorporate within it all features required by the school curriculum. The expansion as it takes place may therefore consist almost entirely of classroom units, or it may be that the departments will be moved in their entirety to these new units, as would have been the case had the whole been built at once.

Aside from the regular academic studies, provision is made for many of the courses so desirable for a girls' school. There are the usual laboratories for chemistry, physics, biology and physiology, and, what is more distinctive, laboratories for the varied branches of domestic science and household arts.

Unusual attention is paid to the courses in bookkeeping, typewriting and other commercial subjects, and in connection with this department there is a full-fledged bank, which is run by the students and which operates as a laboratory for those who wish to prepare for responsible positions, after graduation, in office or bank.

The school is particularly proud of its library, and finds it a very valuable adjunct to class work. Space provision has been made for a reading-room accommodating about 100 students at a time, with stack-room and librarian's office adjoining.

Art and music departments are provided for on the third floor, with adequate studio requirements arranged for in both cases.

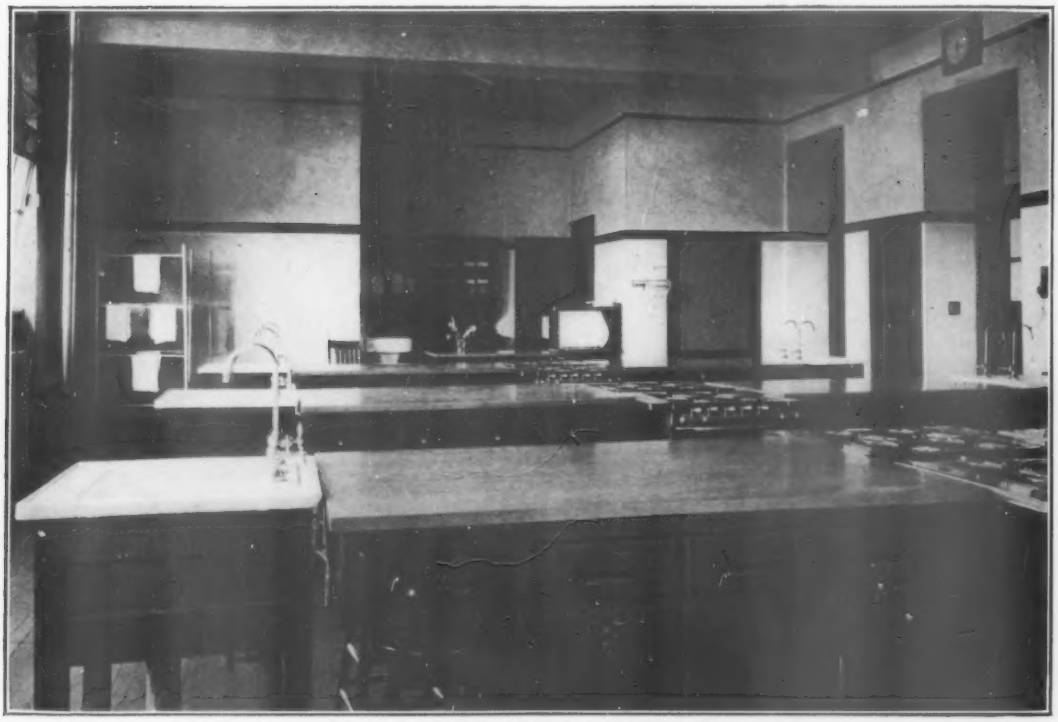
Perhaps the most appreciated feature of the building from the recreation standpoint is the rotunda. Here the students find an exhibition center wherein are placed on view all sorts of exhibits illustrating the work of the school, and a social center where one may meet a friend or have a dance at recess on the way to or from the cafeteria.

Attention should be called to the third floor terraces, which in good weather are very much in demand by the students during periods of relaxation.

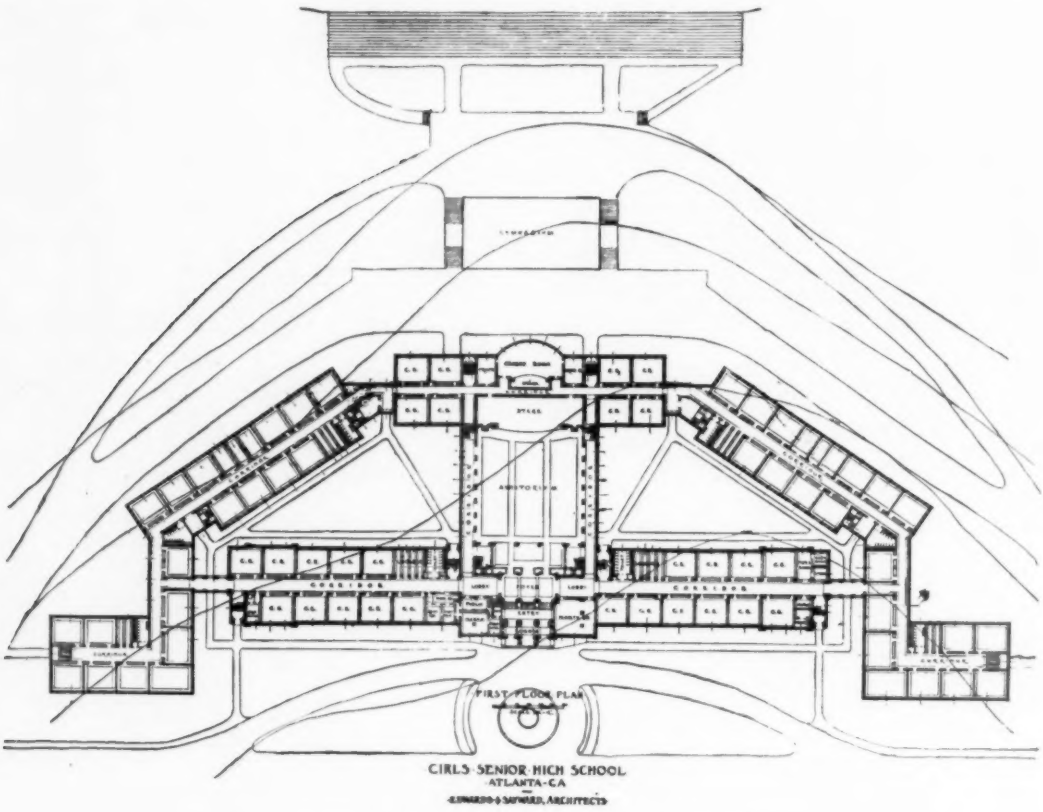
PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Art and Laboratory Equipment—E. H. Sheldon & Co.
Blackboards—National Slate Blackboard Co.
Boilers—R. D. Cole Mfg. Co.
Classroom Furniture—American Seating Co.
Clocks and Signal Systems—Standard Electric Time Co.
Drinking Fountains—The Halsey W. Taylor Co.
Fire Alarms—Holtzer-Cabot Electric Co.
Heating and Ventilating System—Warren Webster & Co.
Home Economics and Biological Laboratory Equipment—Kewaunee Mfg. Co.
Insulation—Johns-Manville, Inc.
Lockers—Durabilt Locker Co.
Sanitary Equipment—Crane Co.

ONE OF THE ROOMS OF THE DOMESTIC SCIENCE DEPARTMENT



ANOTHER ROOM DEVOTED TO HOUSEHOLD ECONOMICS



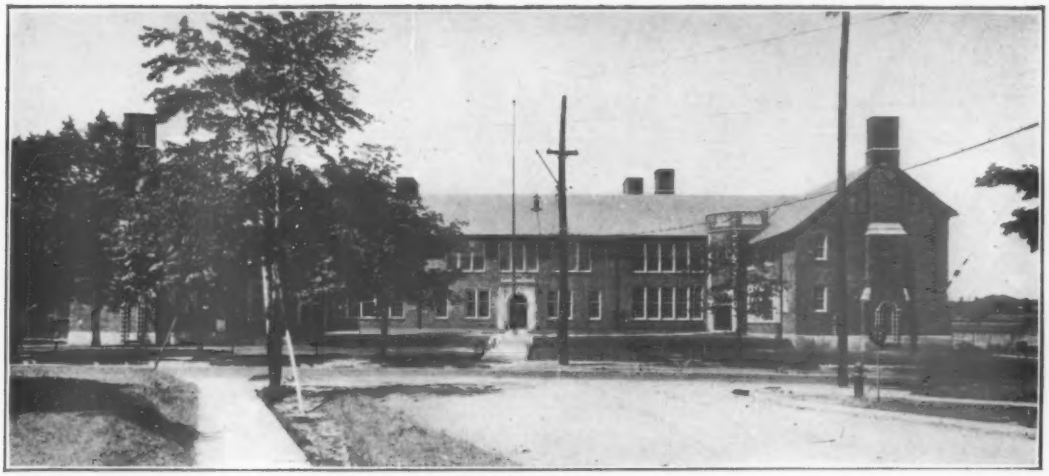
Features of the second and third floors and basement are as follows:

Second floor: Balcony and upper part of stage of auditorium; organ loft, practice and dressing-rooms; 8 coat-rooms; commercial department rooms; library; domestic science rooms; clothing laboratory; toilets; and lockers.

Third floor: Chemical laboratories (2); biological laboratory; physics laboratories (2); physiology laboratory; drawing and arts and crafts rooms; exhibition room; toilets and coat rooms; rotunda and upper part of auditorium.

Basement: Lunch room; teachers' lunch room; kitchen, storage and food service rooms; gymnasium; repair shop; toilets and coat rooms. (Only partially excavated.)

The architects of the building are Edwards & Sayward, Atlanta, Ga. The photographs reproduced with this article are by Tebbs & Knell, Inc., New York.



FRONT VIEW OF THE SCHOOL

The Jefferson Elementary School, Battle Creek, Michigan

BY WM. B. ITTNER, F.A.I.A.
St. Louis, Mo.

THE Jefferson Elementary School at Battle Creek, Mich., completed June, 1927, is an example of some of the significant changes that have developed recently in the field of elementary school planning. With the enrichment of the curriculum and the consequent changes in methods of organization and teaching, elementary schools have advanced from pure study schools to real educational centers where children may grow and develop naturally in a stimulating and beautiful environment. Health, worthy home membership and good citizenship as goals of education today are as important for elementary education as the fundamental operations. The Jefferson Elementary School provides facilities for physical education, for the social sciences, for shop work, for problems pertaining to the home, and for worthy use of leisure.

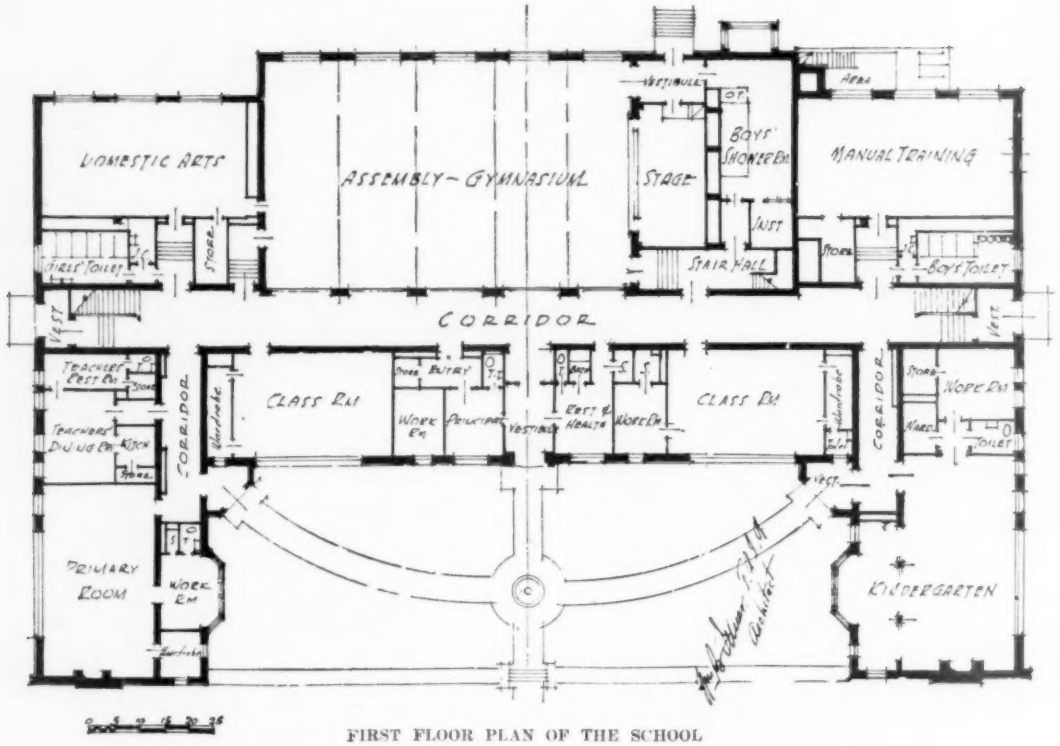
Battle Creek, like many other cities, has adopted the 6-6 plan of the Senior-Junior-Elementary organization. The Jefferson School, therefore, serves the first six grades and kindergarten. The plans reveal a gymnasium-auditorium with a stage, adequate shower facilities, shop and domestic arts rooms, a school library with workroom and librarians' rooms adjacent, and twelve classrooms. Eight of the classrooms and the kindergarten are provided with workrooms of varying sizes.

The plan is of the semi-open type with classrooms arranged around an open court. Maximum light and air penetration is possible for all the educational units. The gymnasium-auditorium is planned essentially as a gymnasium with flat floor and movable seatings. With dimensions of 74 x 46 x 22 feet, its maximum capacity for auditorium uses is 500. An outside entrance facilitates its community uses. The dimensions of the two special rooms, the shops and domestic arts, are 22 x 42 feet, respectively. Both are located on the main floor, and the boys' shop is accessible from the outside. The domestic arts room is equipped for both sewing and cooking. Its articulation with the gymnasium eliminates the necessity of a separate cafeteria. The gymnasium unit, therefore, serves multiple uses.

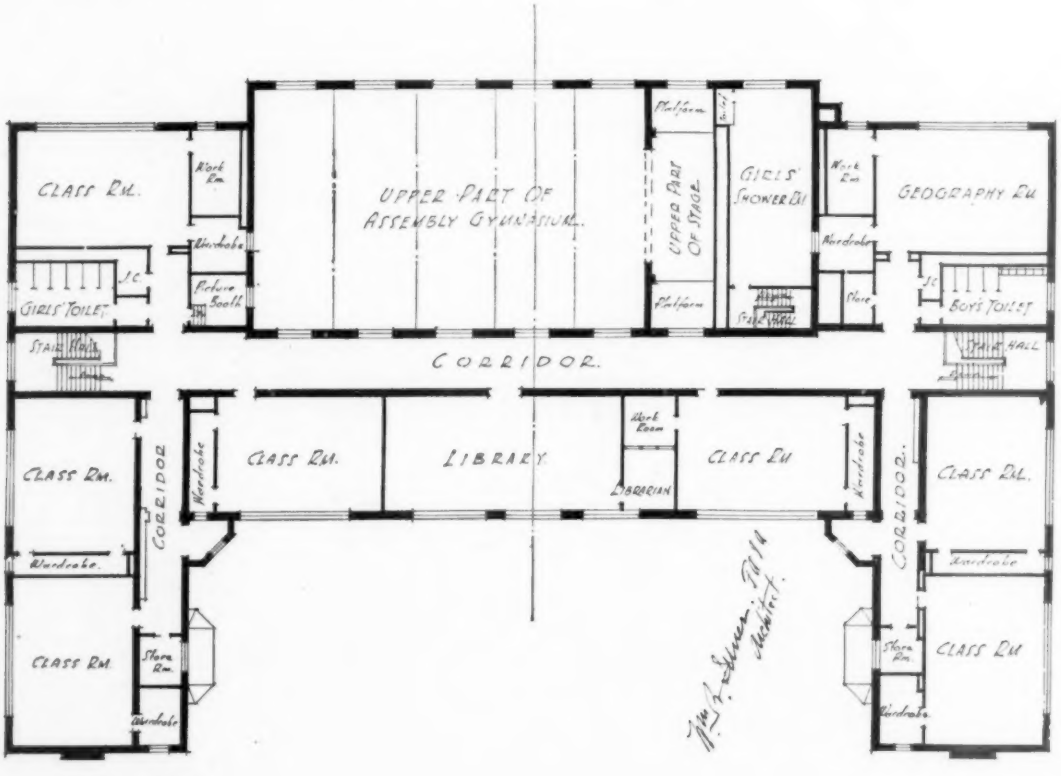
A departure from the usual is noted in connection with the classrooms. Classroom methods in this school call for small adjoining workrooms. These vary somewhat in dimensions, but each one is approximately about one-third classroom size. Small groups of pupils engaged on projects calling for handwork equipment and materials use these workrooms under the supervision of the classroom teacher.

Battle Creek insists on beautiful as well as educationally enriched schools. The Jefferson School is essentially Georgian, and the brick in variegated tones of red gives richness and life to wall surfaces, while the purple and black of the slate roof add color contrasts. Some limestone trim has been used, especially at the entrances, and half-timbered effects may be noted in the gables.

The total cost of the school approximates $236,473, which, with a normal capacity of 600 pupils, gives a per pupil cost of $395.



FIRST FLOOR PLAN OF THE SCHOOL



THE SECOND FLOOR PLAN

The Miami Senior High School

BY RAY L. HAMON

FORMERLY DIRECTOR OF SCHOOL BUILDING CONSTRUCTION, DADE COUNTY, FLA.

SERVICEABILITY, durability and artistic beauty, in the order named, have been the guiding principles in the planning and designing of the $1,120,000 Miami Senior High School building, opened in February, 1928. There has been a very happy blending of educational planning with architectural design, demonstrating that there is no conflict between the two schools of thought when both are willing to cooperate.

During the past three years Miami, Fla., and its surrounding territory has experienced an unprecedented growth. To solve the school-housing problem of the enormous increase in enrollment, a three-year six-million-dollar school-building program was launched in 1925. The author of this article was called to administer this program, subject to the approval of the County Superintendent and the County School Board. The major projects are the Dade County Agricultural High School and the Miami Senior High School, the latter of which is discussed and illustrated in this article.

Kiehnel and Elliott, of Miami and Pittsburgh, were selected as architects for the Miami Senior High School project. The architects were made responsible for architectural design, structural and mechanical engineering and technical supervision of construction. The Director of School Building Construction has directed the educational engineering as to size of rooms, location of various departments and all questions pertaining to planning from a standpoint of educational administration. The Director has been in constant touch with the Superintendent, Principal, department heads and supervisors, and every effort has been made to plan each department to best fit its particular needs.

The main building is of the E type with two additional side wings. The building faces north and the five wings extend to the south, giving east and west light in the majority of the rooms. The rears of these five wings are connected on the first and second floors by open corridors. These arched passageways do not materially obstruct the prevailing southeast breezes which blow through the patios and ventilate the classrooms. Cement breeze-grilles are placed over the blackboards on the right side of the classrooms to provide circulation of air through the rooms and corridors. No heating system has been provided, as the Miami winter climate is so mild that artificial heat is unnecessary.

The plant has adequate accommodations for a senior-high-school student body of 2,500 in all departments. The contract cost of this school plant was $1,120,000. The building has the following provisions: 69 classrooms, 11 laboratories, 4 shops, a library, 2 study halls, a cafeteria, 12 conference rooms, a 230-capacity and a 1,290-capacity auditorium, gymnasium, custodian's apartment, museum, administration offices, rest rooms for women, men, girls and boys, also ample toilet and lavatory facilities. The main building covers a 5-acre city block, and the gymnasium and athletic field occupy an adjacent 5-acre block.

Fireproof Construction

The building is of triple-class-A fireproof construction. The structural columns, girders, beams and slabs are of structural steel and reinforced concrete. Curtain and partition walls are of terra cotta tile. The roofs are constructed of concrete and gypsum slabs with built-up and Spanish tile covering. The toilet and shower-room floors and wainscoting are of ceramic tile, the corridor floors are quarry tile, classroom floors are edge-grain all-heart pine, and the floor coverings of offices, cafeteria and library are battleship linoleum. The exterior of the building and the open corridors are finished in soft buff shades of Spanish stucco. The interior corridor wainscoting and lockers are finished in French gray. The building is set about 3 feet above grade and pipes are hung below the first floor slab, so they are accessible for repairs. The architecture is of the thirteenth-century Sicilian type, but modified to fit an educational plant. A very beautiful architectural effect has been obtained by the lines of the building and the use of precast stone and Spanish tile. When the tropical landscaping has been completed, the entire plant will be one of the most beautiful in America.

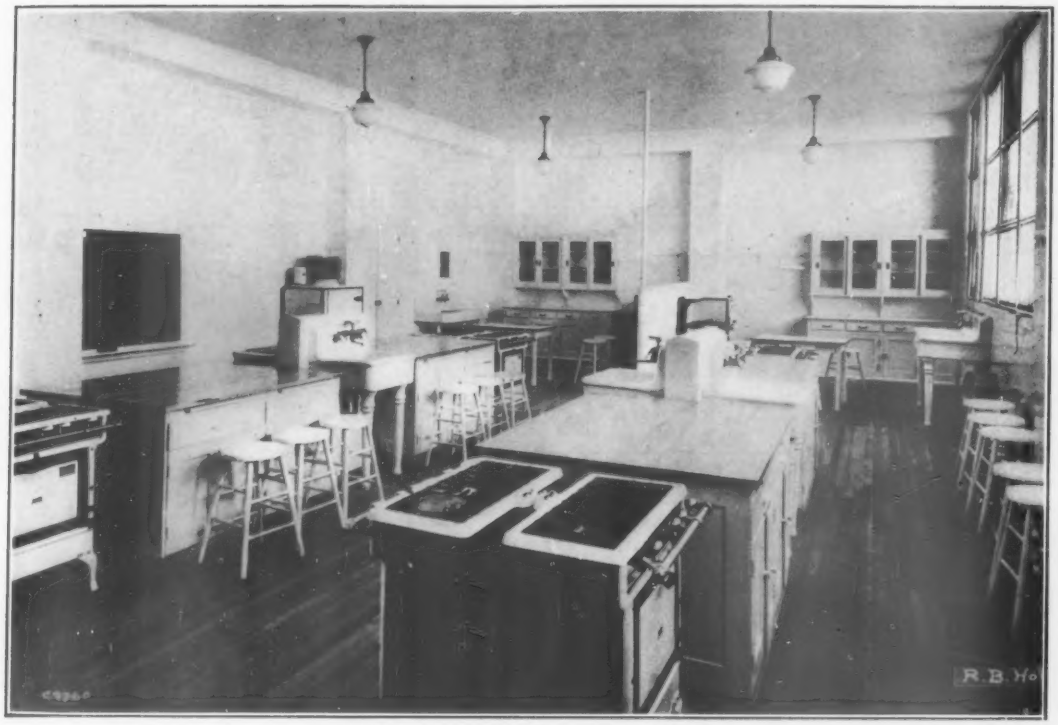
A typical classroom is 22 x 26 x 12 feet and is equipped with 28 seats, a teacher's desk, a built-in bookcase, a reading table and six chairs. Natural slate blackboards are installed on three walls of mathematics rooms, front walls only of laboratories, and front and right walls of other classrooms. Each room has a 4 x 3½-foot cork bulletin board. A typical classroom has five awning type steel windows arranged in a single battery 5 feet from front wall, 1 foot from rear wall, 4 feet from floor and 2 inches from ceiling. The glass area is equal to 21 per cent of the floor area.

How the Departmental Idea Has Been Carried Out

The departmental idea has been carried out in the new Miami Senior High School building. Each department has, in addition to its regular classrooms and laboratories, a conference or con-

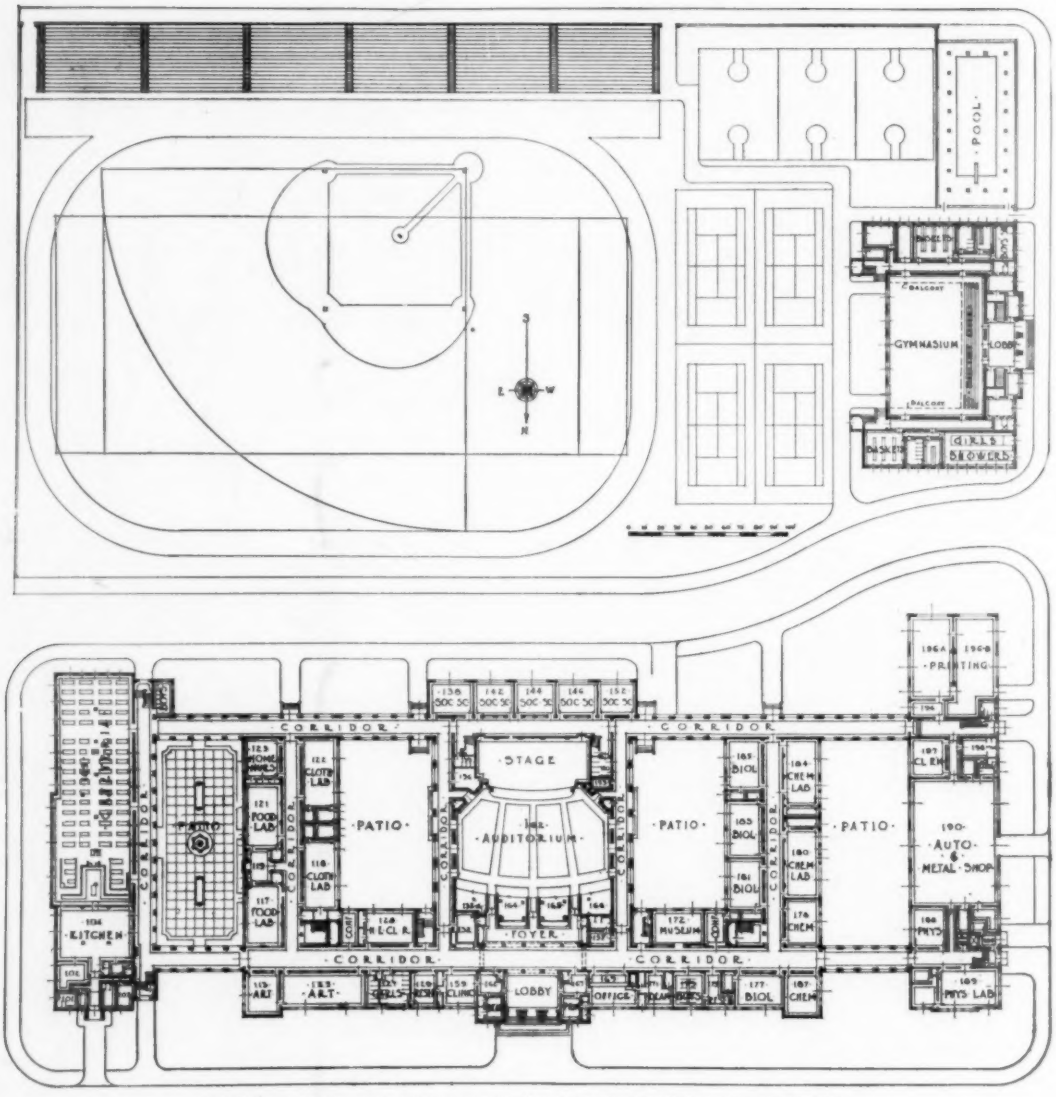
ONE OF THE FOUR PATIOS IN THE MIAMI SENIOR HIGH SCHOOL

THE GIRLS' STUDY HALL



A FOOD LABORATORY IN THE SCHOOL

THE ARCHITECTURAL DRAFTING ROOM



FIRST FLOOR AND PLOT PLAN OF MIAMI SENIOR HIGH SCHOOL

sultation room. These consultation rooms are for conferences of department heads with teachers and teachers with students. All the rooms of each department are conveniently located together. In locating the various departments, special attention has been given to the relationship between the departments.

The music department occupies the fourth-floor tower and consists of a large choral room and two classrooms. The entire third floor is given over to English. This department has 16 classrooms, a dramatics and debating auditorium, and workrooms adjacent to the annual and journalism rooms.

The study-library department occupies the entire second floor of one wing. The boys' study hall has a seating capacity of 235 and the girls' study hall seats 253. Between the two study halls is a completely equipped modern library with a seating capacity of 160. This department also has a workroom and conference room.

The various academic departments have the following number of classrooms: mathematics, 11; social science, 10; Latin, 5; French, 2; Spanish, 4.

The commercial department has two typewriting rooms, a bookkeeping and banking room, a room for calculating machines, a classroom for commercial arithmetic and commercial law, a classroom for shorthand and a room for secretarial training.

The boys' vocational department has two large well-equipped printing laboratories, a building engineering shop, an auto mechanics shop, two

drawing rooms and two classrooms, and has ample provision for stock rooms, offices and locker rooms.

The science department has a laboratory for physics, a physics classroom, two chemistry laboratories, two chemistry classrooms, four biology rooms and a museum.

The home economics department has two food laboratories, two clothing laboratories, a living room, a home nursing room and a classroom.

In the fine-art department there is one standard size classroom for oil painting and one double classroom for free-hand drawing. These fine-art rooms have running water, display cases and display bulletin boards.

The cafeteria has a dining-room which seats six hundred. The students are fed in three 30-minute shifts. The cafeteria has a completely and fully equipped kitchen, refrigeration plant, storeroom, two dressing-rooms and office.

The physical education department has a complete gymnasium and athletic field. The gymnasium has a regulation basketball court, directors' rooms, shower rooms, toilets and locker rooms. The balcony and bleachers have a seating capacity of one thousand. The boys' department has the basket-locker combination system. In the girls' shower room there are four private dressing-rooms around each shower.

Bowl-shaped Auditorium and Other Special Features

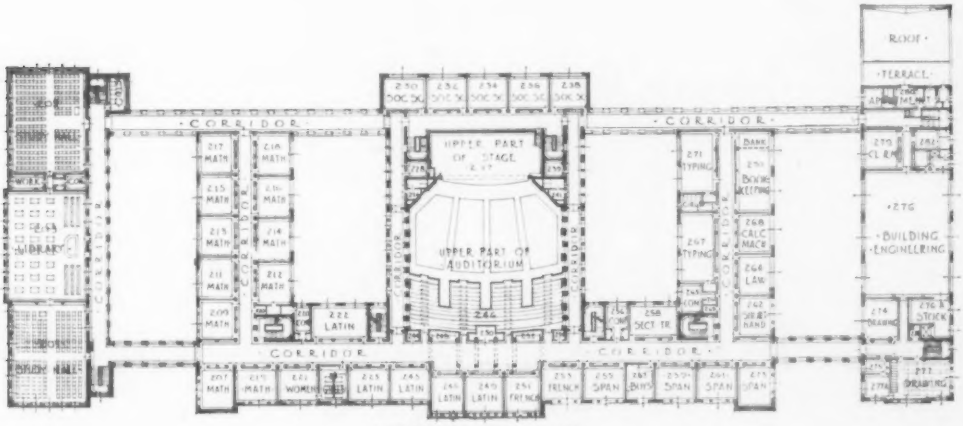
The bowl-shaped auditorium has a seating capacity of 1,290. It has a picture booth with spot light, projection machine and a fully equipped theatrical stage. The architecture is exquisite and the acoustic properties are very good. Provision has been made for the future installation of a pipe organ. Auditorium dressing-rooms are not used frequently, but when they are needed, large ones are required. To cut down the cost, five standard classrooms have been located adjacent to the stage and can be used as dressing-rooms when necessary.

Some of the special features in this new high school plant are: a three-room apartment for custodian; first aid and dental clinic; office for dean of boys, office for dean of girls; wide, spacious corridors; ample and conveniently located stair exits; a steel locker recessed in the corridor wall adjacent to the home-room for each student and teacher; and built-in trophy and display cases in the lobby and foyer. The electric equipment includes a complete program clock system, telephones, fire horns and corridor and playground gongs. Efficiency lighting has been installed throughout, as the building is also used for evening classes.

Eighteen hundred senior-high-school students moved into the new building on the fourteenth day of February. It is expected that this plant will be filled to maximum capacity during the fall of 1928. It is considered in this county that 2,500 should be the maximum enrollment for senior high schools. When we have filled this and our other senior high school buildings to capacity, another plant will be erected.

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Art Equipment—Kewaunee Mfg. Co.
Auditorium Seats and Classroom Furniture—American Seating Co.
Blackboards—Natural Slate Blackboard Co.
Cafeteria Equipment—S. Blickman, Inc.
Clocks and Signal Systems and Fire Alarms—International Time Recording Co.
Laboratory Equipment—Kewaunee Mfg. Co.
Library Equipment—Library Bureau.
Lighting Globes and Fixtures—General Electric Co.
Lockers—Lyon Metal Products, Inc.
Office Equipment—Yawman & Erbe Mfg. Co.
Windows and Sash—Truscon Steel Co.



SECOND FLOOR PLAN

LINCOLN STREET FRONT OF THE BOYDEN HIGH SCHOOL, SHOWING MAIN ENTRANCE, FORE COURT BETWEEN AUDITORIUM AND GYMNASIUM, AND RADIO TOWER

The Boyden High School, Salisbury, North Carolina

BY C. GADSDEN SAYRE

ARCHITECT, GREENSBORO, N. C.

THE Boyden High School at Salisbury, N. C., was erected on a beautiful site of 21 acres on Lincoln Street approximately one mile from the center of the city, which has a population of nearly 14,000 people. The cost was $535,000, not including the site, but including the cost of the building itself, $475,000, of the furniture, $50,000, and of the landscape work, $10,000. The building contains 1,574,000 cubic feet and cost 29 cents per cubic foot, including mechanical equipment, but exclusive of architect's fees and furnishings.

The building is of fireproof construction throughout with reinforced concrete frame, floors and roof. The exterior is faced with rough-texture buff brick with cream-colored terra-cotta trimmings. The floors are of maple throughout, with the exception of floors in the halls and staircases, which are of terrazzo, and the library floor, which is of battleship linoleum. The interior woodwork and doors are of natural finish white oak, the plastered ceilings are painted ivory, and the walls rich cream with a russet dado.

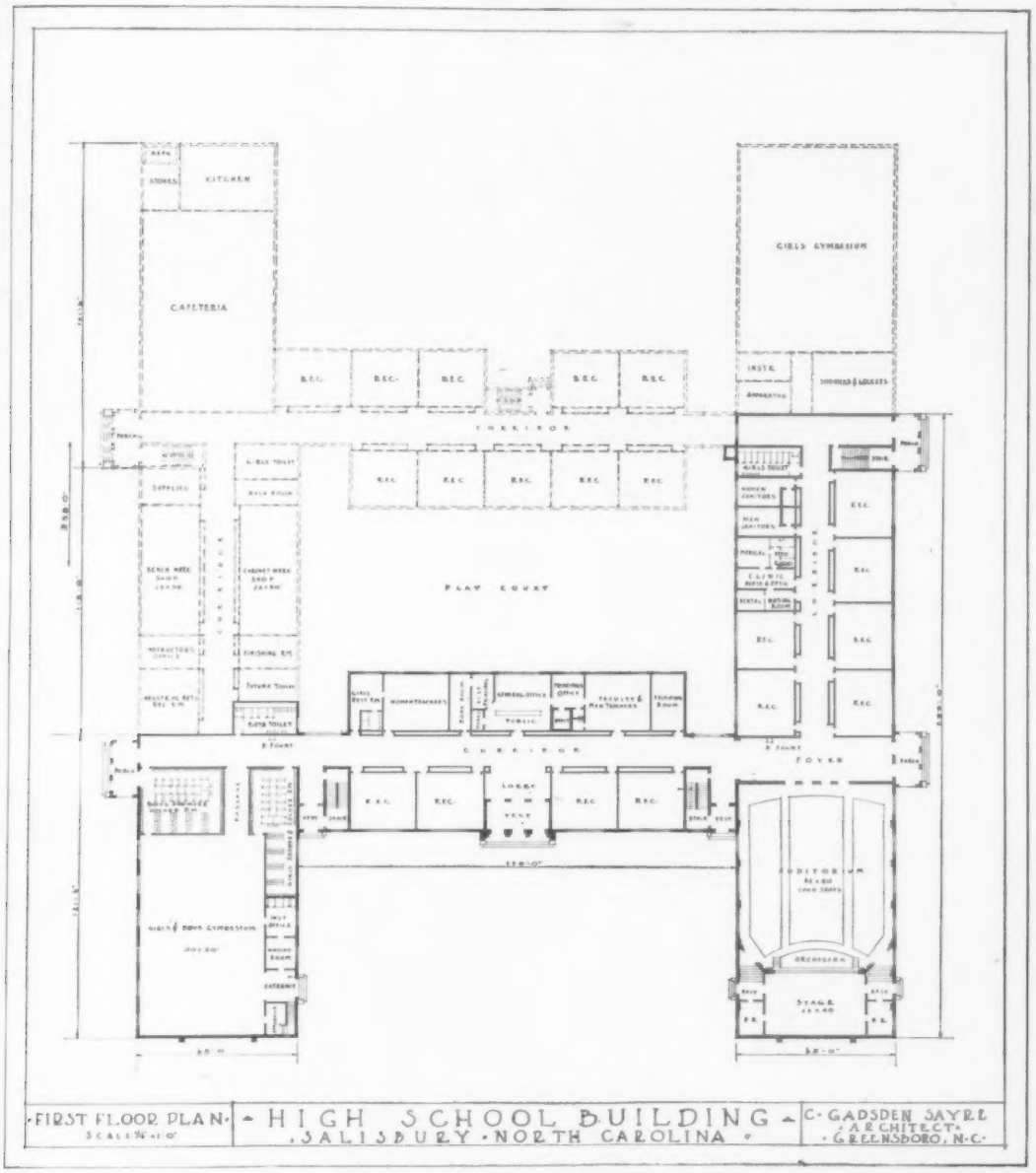
The building has a capacity of 1,000 students. It has a total of 61 classroom units, in addition to an auditorium seating 1,000 and a large gymnasium. The building is planned for future extensions to the rear, as indicated on the plans, which, when built, will double the present capacity.

A novel feature of the building is a large room for radio and electrical research on the top floor of the tower. Another interesting feature is the arrangement and equipment of the physics and chemistry laboratories, in both of which are used 32 desks of a type which enables these rooms to be used for lectures as well as for student experimental work. Each desk is equipped with outlets for both alternating and direct current for any voltage up to 110 supplied with current from a large rotary converter or motor generator and ample storage batteries placed in an instructor's room adjoining the physics laboratory. There is a large switchboard in the physics laboratory controlling the supply of this current not only to the laboratories mentioned but also to the instructors' desks in the general science and biology laboratories and the radio room. This makes possible a much wider range of experiments in physics and chemistry than is afforded by the usual facilities.

The corridors are wide and well lighted with direct light. Ample provision has been made for circulation and exits by eight main ground-floor entrances and five main fireproof stairs adjacent to the entrances.

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Auditorium Seats and Classroom Furniture—American Seating Co.
Boilers—Kewanee Boiler Co.
Cafeteria Equipment—Albert Pick & Co.
Clocks and Signal Systems and Fire Alarms—Standard Electric Time Co.
Gymnasium Equipment—Fred Medart Mfg. Co.
Heat Regulating System—Johnson Service Co.
Laboratory Equipment—Kewaunee Mfg. Co.
Library and Office Equipment—E. H. Sheldon & Co.
Lockers—Fred Medart Mfg. Co.



The principal features of the second and third floor plans are as follows:

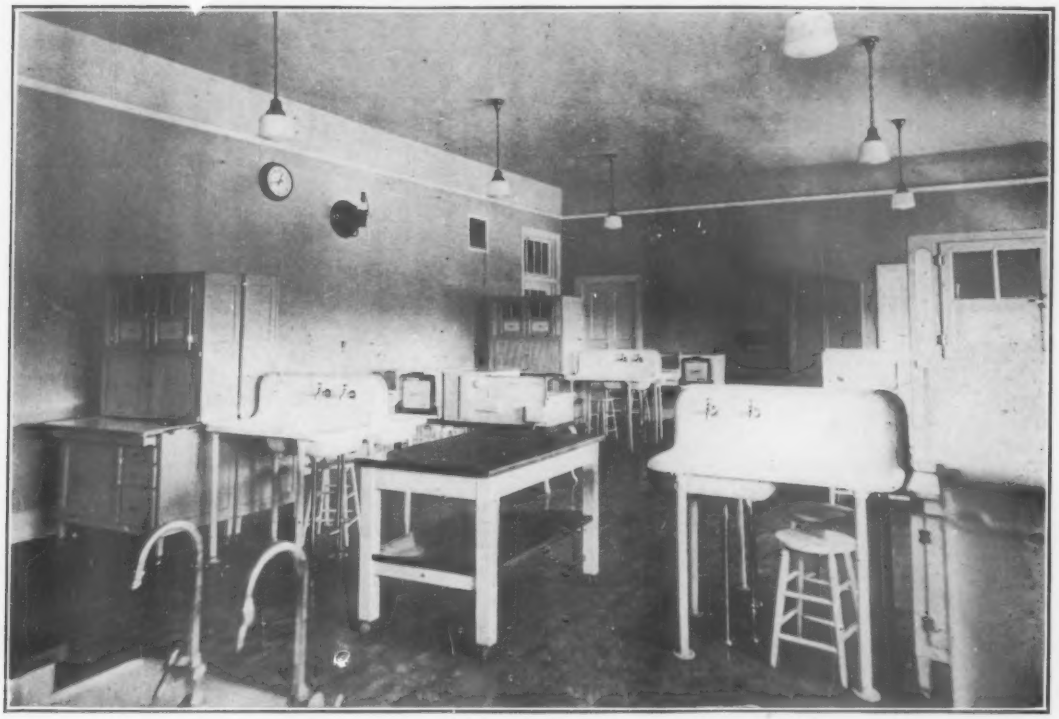
Second floor: Upper gymnasium with gallery seating 400, upper auditorium with stage and balcony, library and study hall, 13 recitation rooms, 2 art rooms, boys' and girls' toilets; future extension to rear provides for 16 additional recitation rooms, study hall, upper gymnasium with gallery, and 2 toilets.

Third floor: Physics laboratory with adjoining instructor's and dark rooms, general science laboratory No. 1, with adjoining instructor's room, general science laboratory No. 2, biology laboratory, chemistry laboratory with adjoining instructor's and dark rooms, stenography and commercial arithmetic room, bookkeeping room with adjoining bank and office room, typing room, clothing laboratories No. 1 and 2 with fitting room and supply room between, bedroom, food laboratories No. 1 and 2, dining-room, supply room, recitation room; future extension to rear provides for 19 additional recitation rooms, food laboratory, dining-room, living-room, and boys' toilet.

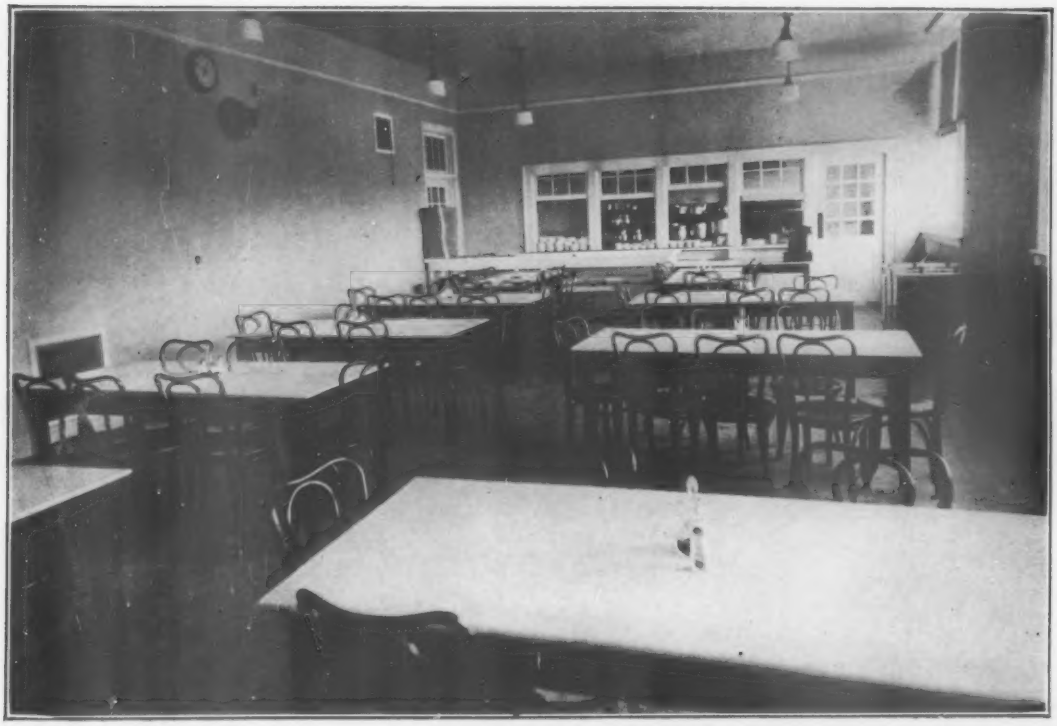
The present and future sections of the floor plans are shown with a large court between them, on which the inside rooms look out.

CORRIDOR IN THE BOYDEN HIGH SCHOOL, SHOWING RECESSED LOCKERS

THE SCHOOL'S CHEMICAL LABORATORY, SHOWING DESKS AND RECESSED FUME-HOODS



FOOD LABORATORY NO. 1, WITH "UNIT KITCHENS"



A VIEW OF THE CAFETERIA

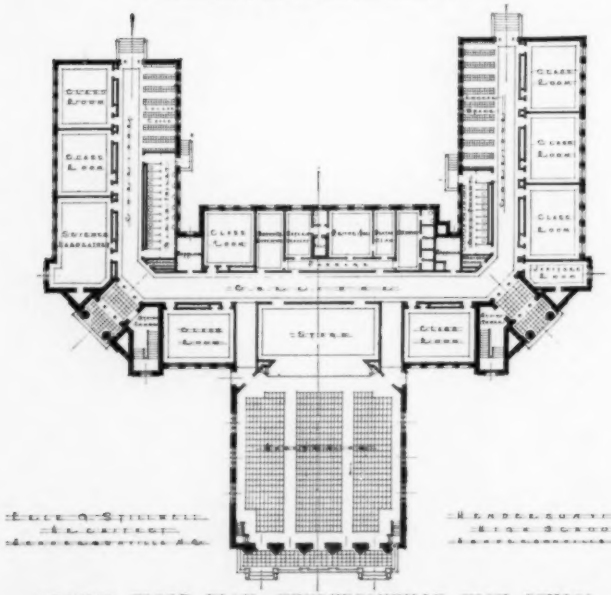
WEST ENTRANCE OF THE HIGH SCHOOL

The Hendersonville High School

Floor Plan and Five Photographs from

ERLE G. STILLWELL

ARCHITECT, HENDERSONVILLE, N. C.



GROUND FLOOR PLAN, HENDERSONVILLE HIGH SCHOOL

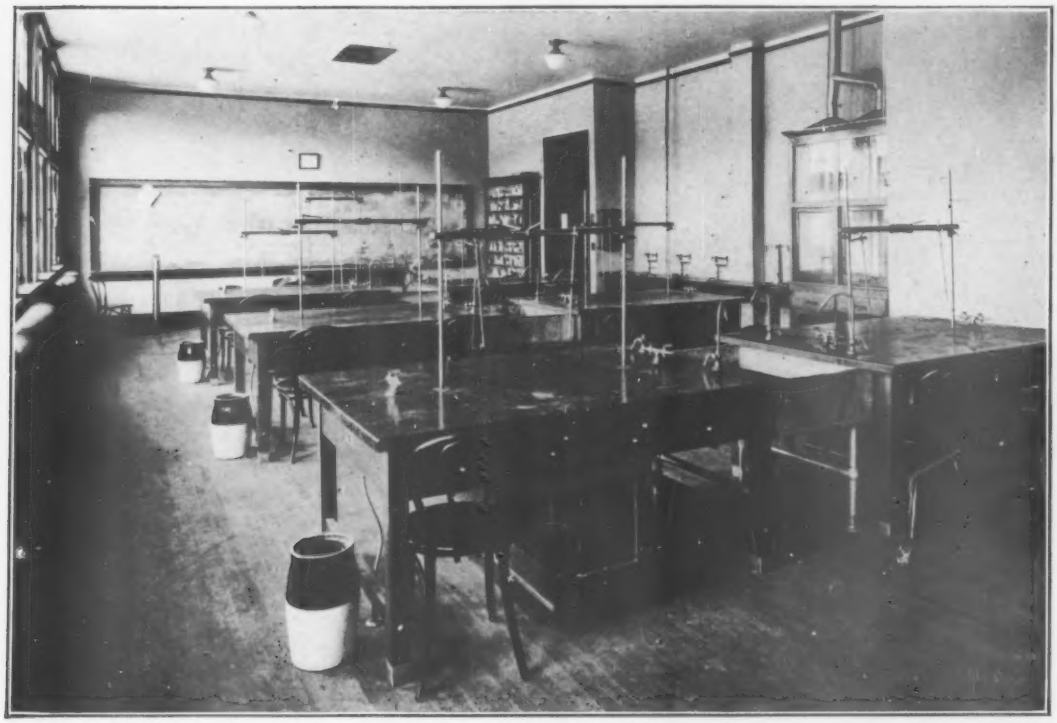
Features of the first and second floors are:

First floor: Balcony of auditorium and stage loft; library, study hall, women teachers' room, men teachers' room, boys' student activities room, girls' student activities room; classrooms (8); locker spaces (2), boys' toilet, girls' toilet; janitor's closets (2), work room, and supply room.

Second floor: Cooking laboratory with dining-room and pantry; clothing laboratory; commercial room with bank, typewriting room; chemistry laboratory with instructor's room and dark room, physics laboratory with instructor's room, storage room for sciences; classrooms (8); private instructor's room; locker spaces (2), girls' toilet, boys' toilet; janitor's closets (2).

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

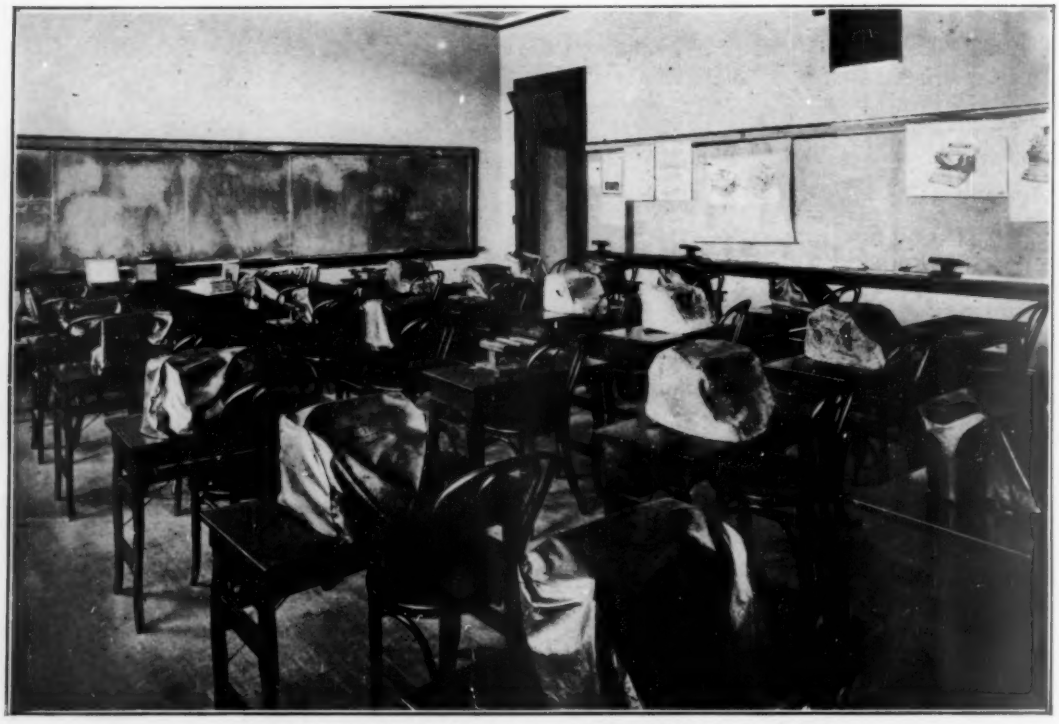
Art Equipment—E. H. Sheldon & Co.
Auditorium Seats and Classroom Furniture—American Seating Co.
Blackboards—Natural Slate Blackboard Co.
Boilers—Kewanee Boiler Co.
Clocks and Signal Systems—Standard Electric Time Co.
Flooring Materials—The Duraflex Co., Inc.
Heating and Ventilating System—Warren Webster & Co.
Heat Regulating System—Johnson Service Co.
Laboratory and Shop Equipment—Kewaunee Mfg. Co.
Library Equipment—Library Bureau.
Lockers—Fred Medart Mfg. Co.
Plumbing Fixtures and Sanitary Equipment—Standard Sanitary Mfg. Co.
Projecting Equipment for Moving Pictures—Translux Daylight Screen Co.



CHEMICAL LABORATORY, HENDERSONVILLE HIGH SCHOOL

THE SCHOOL'S WOODWORKING SHOP

THE HOME ECONOMICS DEPARTMENT



THE TYPEWRITING ROOM OF THE COMMERCIAL DEPARTMENT

Two New Texas High Schools

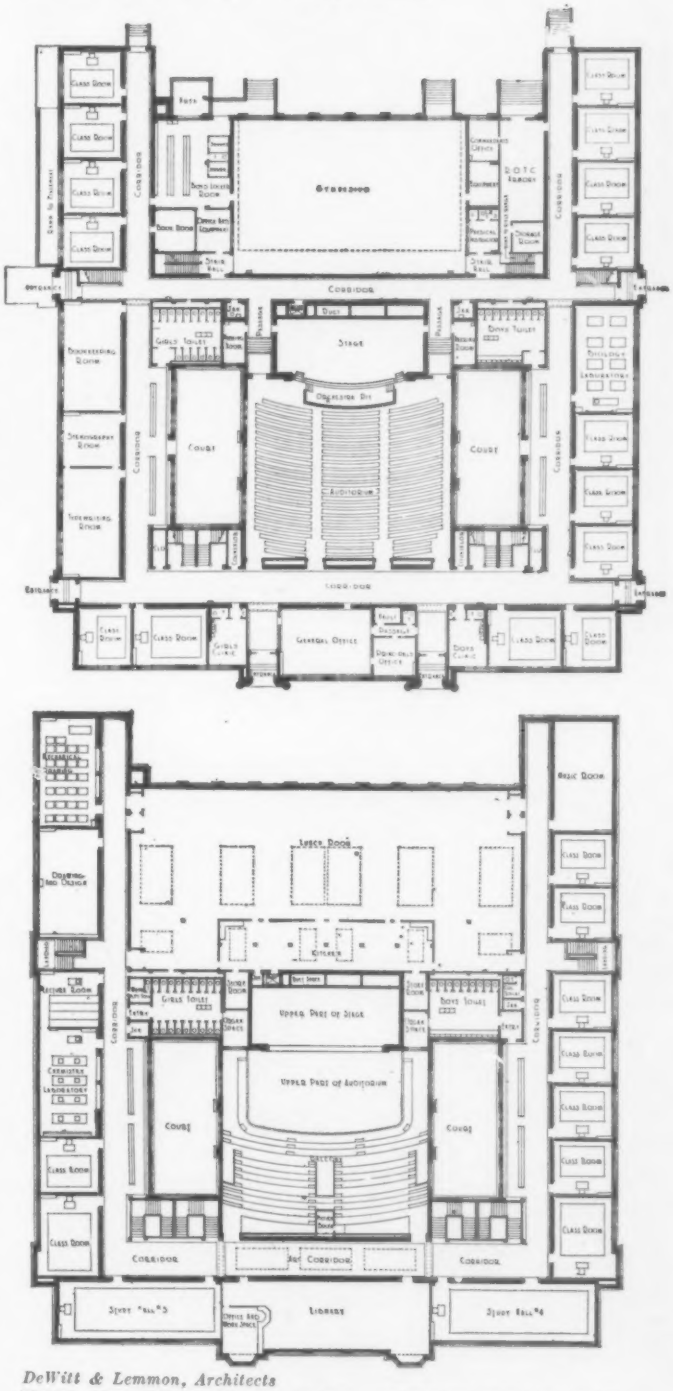
BY MARK LEMMON, A. I. A., DALLAS, TEXAS

Woodrow Wilson High School, Dallas

THE Woodrow Wilson High School completed in time for the opening of the school term in September, 1928, is the sixth high school in operation by the Dallas school system. The building stands on a 10-acre tract facing one of the parks of the city, and is planned with future additions in view. The present building houses 2,200 students, but certain units in the plant as built are designed to care for a student body of 3,000. The cafeteria and kitchen are of a size which will permit the serving of 1,000 students at a sitting. The public office, clinics, auditorium, library and gymnasium, girls' showers, and mechanical plant are also planned for the enlarged enrollment.

It will be found, on an examination of the plans, that no gymnasium facilities are provided for the boys other than showers for the athletic teams. The explanation of this is found in the fact that Dr. Crozier depends on the training derived from the activities of the R. O. T. C. to keep the boys fit. The plans show adequate facilities for the corps, these facilities being so arranged that corps functioning will not in any way disturb the educational activities of the rest of the plant.

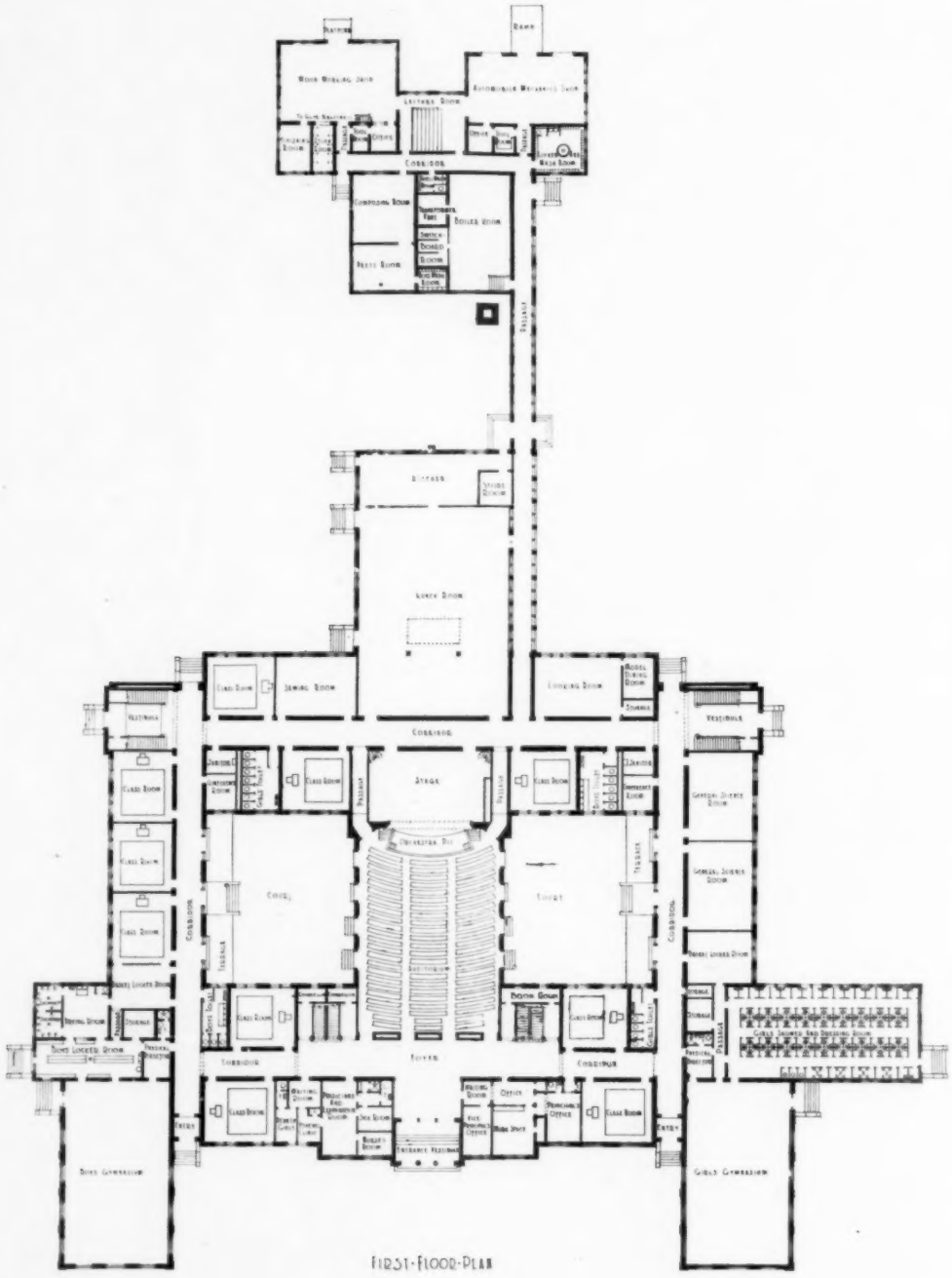
One of the problems confronting the Board of Education has been that of providing proper lunchroom facilities, with the attendant problems of food handling, garbage disposal, etc. The plan in other high schools in the city had been to place the lunch room under the auditorium, which necessitated the bringing-in of food through the educational portions of the building. In the climate of Texas, such planning was found to be not the best, therefore the lunch room in the Woodrow Wilson High School was placed on the top floor. The improvement in lighting and ventilation is apparent. The room is served by elevator from storage rooms in the basement, which are served from the outside by a ramp



DeWitt & Lemmon, Architects

FIRST AND THIRD FLOOR PLANS, WOODROW WILSON HIGH SCHOOL

The second floor contains upper part of stage, and balconies; upper part of gymnasium and two spectators' balconies; two tiers of shower and dressing rooms; 12 class rooms; 2 study halls and one lecture room; physics laboratory; cooking laboratory with model dining-room; and sewing laboratory with fitting room



THOMAS JEFFERSON JUNIOR HIGH SCHOOL, PORT ARTHUR, TEXAS

The second floor of this school contains: upper part of auditorium; balcony and upper part of stage; conference and classrooms; art corridor; music room with practice rooms; library; students' activities room; bookkeeping room; teachers' preparation room, with lockers and toilets; upper part of boys' gymnasium; and upper part of girls' gymnasium

leading from grade to the basement floor level.

Owing to the placing of the lunch room on the top floor, we were able to place the auditorium on the first floor, which is, of course, desirable. The auditorium balcony can be reached from the second and third floors, providing a maximum of safety. The room seats 1,500 students.

The building was erected at a total cost of $672,000, without equipment. It is a Class A building, being of fireproof construction from foundation to concrete roof slab. The brick is trimmed with variegated Bedford limestone, the building being designed in the Tudor style. The interior finish includes terrazzo floors, throughout the corridors and toilets; wood floors in the classrooms; oak trim; tile wainscot in the corridors; and marble wainscot in the toilets.

Thomas Jefferson Junior High School, Port Arthur

Another addition to the school plants of Texas is the new Thomas Jefferson Junior High School for the Port Arthur Board of Education. Port Arthur has long had one of the outstanding school systems in the United States, both as to curriculum and as to physical plant. The Port Arthur Independent School District recently voted $1,500,000 for new buildings and equipment. Of this amount, $500,000 has been set aside for the Thomas Jefferson Junior High School. It should be said at this point that the Port Arthur Board of Education had called in Drs. Strayer and Engelhardt of Teachers' College, Columbia University, for expert advice on school needs before asking for the above bond issue. These gentlemen made an extensive survey of the entire school district, and the present building program is being followed out in accordance with the recommendations of that survey.

The Thomas Jefferson Junior High School is to be the largest operation under the bond issue, and the present plan calls for the housing of 1,200 students. Future additions will be added as needed. The site of 15 acres is surrounded by four important thoroughfares, the building being placed so that the principal façade faces south and is on the axis of Seventh Avenue.

An effort has been made to provide all the educational facilities demanded by a modern school plant, with due regard to the comfort so necessary in a semi-tropical climate. The entire architectural scheme has been thought out with this idea in mind. As will be noticed, the central courts are quite large, and it is felt that the rooms giving on them will be well ventilated.

The building is to be of fireproof construction throughout. The brick used on the exterior will be light in color and will be trimmed with terra-cotta. The roof will be of Spanish tile of variegated colors.

The specifications for the interior call for terrazzo floors throughout the corridors and toilets; wood floors in the classrooms; oak trim; tile wainscot in the corridors and stair halls; and marble wainscot in the toilets.

G. M. Sims, Superintendent of Schools, has just recently put his schools on the 6-3-3 plan, the Thomas Jefferson High School being the first junior high school building. The building has been designed to fulfill the needs of the splendid curriculum developed by Mr. Sims.

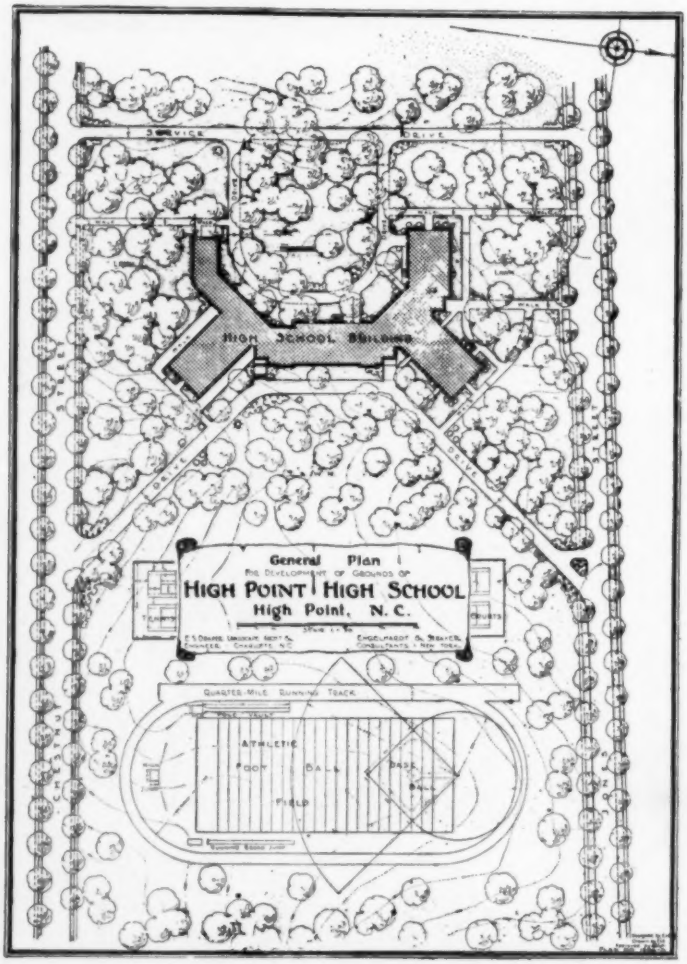
The High Point High-School Building

BY HARRY BARTON

ARCHITECT, GREENSBORO, N. C.

THE new building of the High Point High School is one of the finest in the state of North Carolina. The exterior is designed in the collegiate Gothic style of architecture and is faced with buff brick with architectural terra cotta trimmings. The construction is of fireproof materials. All the floors in the classrooms are of wood over concrete slabs. In the lobbies and corridors are floors of terrazzo.

The plan, when ultimately completed, will be U-shaped, with the auditorium and gymnasium wings projecting obliquely from the base of the U. As one approaches the building, he is instantly impressed with the fact that it was planned to suit the topography of the site.



The building, as it now stands, furnishes accommodations for about 1,200 pupils, although this number could be increased by a few hundred, if necessary.

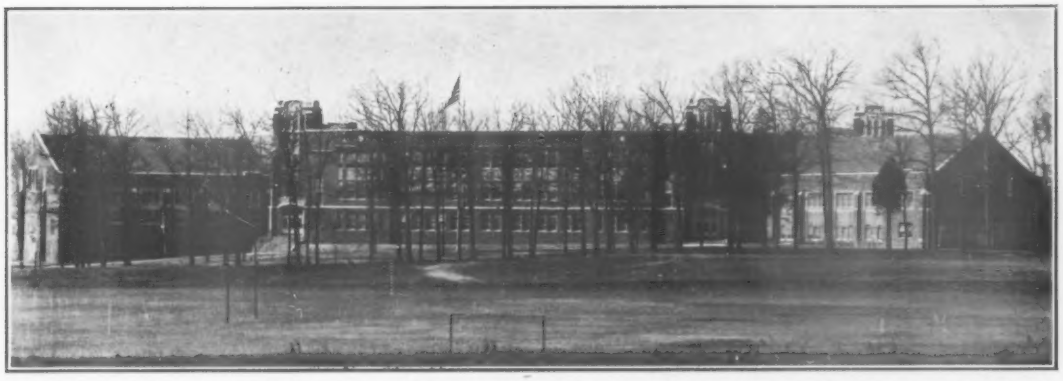
The two entrances on the east of the main front are emphasized by towers. Between these two towers in the first story is located the administration suite, which includes the public office, offices for the principal, dean of girls, medical and dental clinic, nurses' room, waiting-, book- and store-rooms. Adjacent to the principal's office is a large fireproof vault for the storage of records. To the right of the east front is the auditorium wing. This auditorium will seat over 1,300 people. It is equipped with a moving-picture projection booth, a large stage and dressing-rooms.

Along the corridor opposite the entrances to the auditorium are the kitchen and cafeteria, fully and modernly equipped. This cafeteria will be conducted by the school authorities and will enable the pupils to get a well-cooked, hot lunch at barely more than actual cost.

Adjacent to the cafeteria is a small dining-room for the faculty. In the basement, under the cafeteria and kitchen, are located several store-rooms for the storage of food and other supplies.

To the left of the east front is the gymnasium wing. The floor space of the gymnasium is 62 x 88, and is large enough for two practice basketball courts. The gymnasium is fully equipped with modern apparatus. The balcony at one end, with the portable bleachers provided, will give a seating capacity of over 900 for the championship games. Connected with the gymnasium is an office for the physical director and a store-room for the storage of the apparatus, when not in use.

Immediately under the gymnasium on the ground floor in two sections are well lighted and ventilated locker and shower rooms—one section for boys and the other for girls. In the boys' section, separate accommodations have been provided for the use of visit-



PANORAMIC VIEW OF HIGH POINT HIGH-SCHOOL AND GENERAL PLAN FOR DEVELOPMENT OF GROUNDS

ing teams. The locker and shower rooms are convenient of access from either the athletic field or the inside of the building. On the opposite side of the corridor from the gymnasium wing are the mechanical drawing-room and the wood-working bench and machine shops.

In the north wing is the thoroughly equipped food laboratory, where instruction will be given in cooking, balanced diets and the scientific management of foods; there is also a sewing laboratory where sewing and clothes making will be taught.

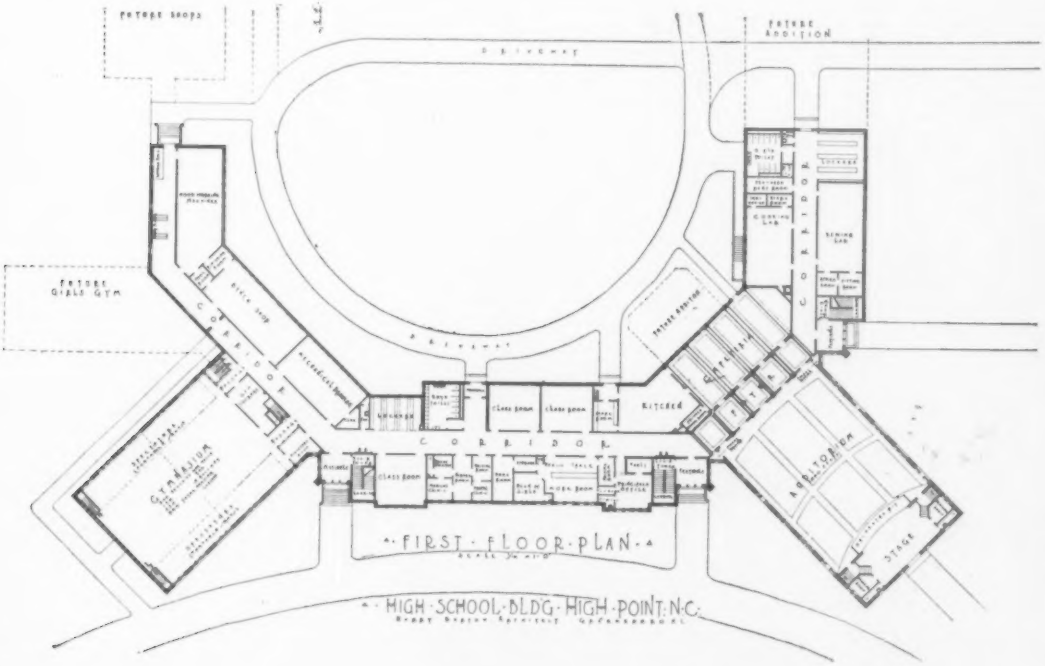
In the second story are the biology and general science laboratories. Opposite the auditorium wing is a spacious library which communicates with two large study halls. The balconies of the auditorium and gymnasium are entered from the second-story corridors.

In the third story are the physical and chemical laboratories.

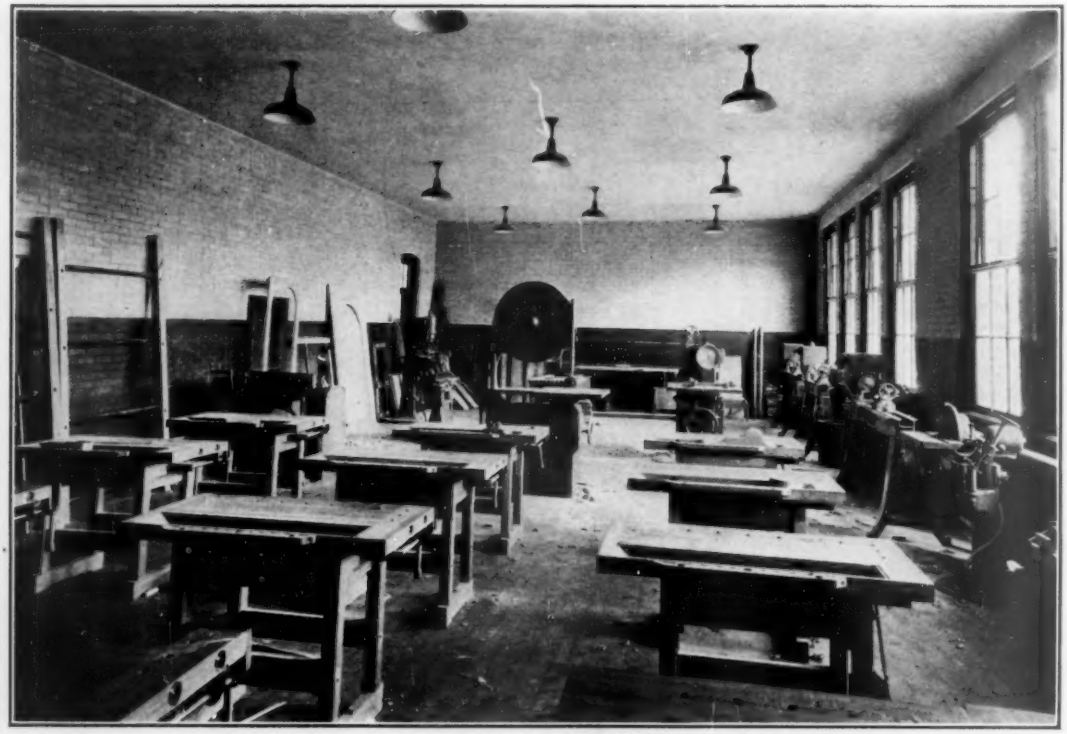
Conveniently located throughout the building are the regular classrooms, locker and toilet rooms.

The heating plant and the mechanical equipment machinery are in the basement. The building is mechanically ventilated and under automatic temperature control.

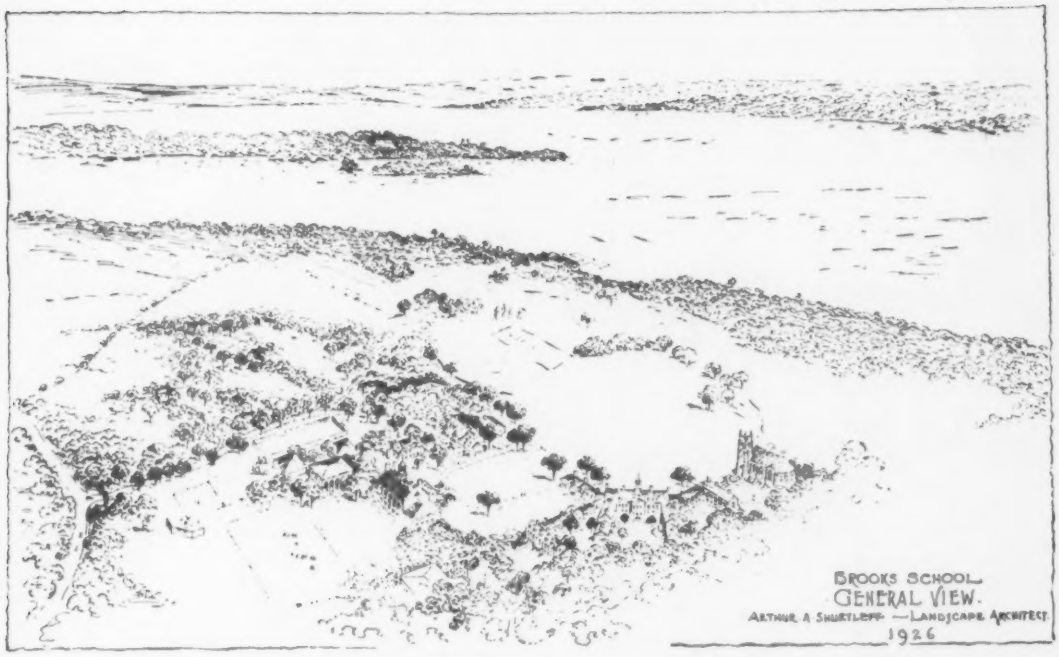
The driveways, walks and shrubbery will add much to the beauty of the landscape and furnish a pleasing setting for the building.



THE LIBRARY, HIGH-SCHOOL BUILDING, HIGH POINT, N. C.



THE WOOD-WORKING SHOP



THE BEAUTIFUL LOCATION OF THE BROOKS SCHOOL AT NORTH ANDOVER, MASS.

The Development of the General Plan for a Boys' School

BY ARTHUR A. SHURTLEFF

LANDSCAPE ARCHITECT, BOSTON, MASS.; PRESIDENT, AMERICAN SOCIETY OF LANDSCAPE ARCHITECTS

WHEN the earliest American colleges and schools were built, much consideration was given to the placing of buildings and approaches. Seventeenth and eighteenth century records of William and Mary College in Maryland, and of Harvard College and Yale College in New England, indicate a pretty clear realization of the importance of general planning. To the discredit of the governing authorities of most American colleges and universities, the admission must be made, however, that good planning was not a characteristic of our educational institutions in the later centuries.

Fifty years ago chaos in the physical plans of most of our colleges and schools began to show itself broadcast across our whole land. That period fortunately marked the extreme erratic swing of the compound pendulum of wisdom, preoccupation and folly. Today we see methodical plans under consideration for most forward-looking schools and universities. To secure moneys for building projects is difficult unless donors are confident that gifts will be used intelligently in a program which will insure a high degree of convenience of operation and at the same time promise a substantial surety of good appearance, both in the arrangement of buildings and in the structures themselves.

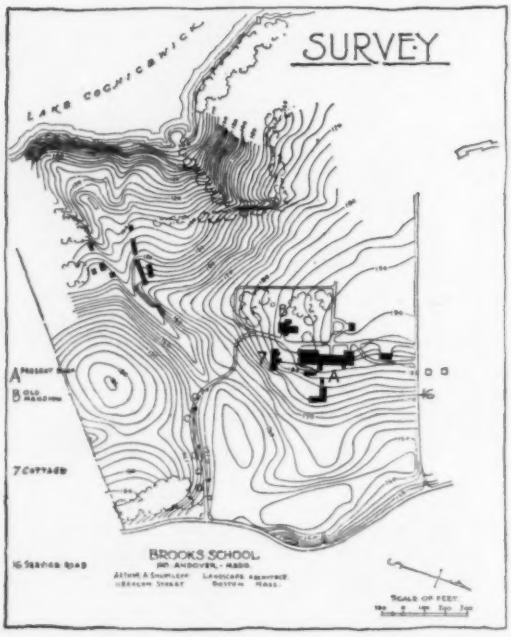
Success in the early days resulted from a rather compact manner of arranging buildings in groups around quadrangles, and a not too uniform style of simple architecture in few materials. Failure came later when buildings were scattered about like dominoes in the lap, and when the buildings themselves became conglomerates of wood, brick, stone and terra cotta, with a fusion of all architectural styles and periods. There is, of course, no one scheme of layout which can be used for all kinds and conditions of colleges, universities and schools. Fortunately, much variety is required by conditions of use and by topography, as well as by climatic conditions. There are, however, general lines of approach which are common to all programs for the layout of educational groups. The following notes attempt to review a few of these considerations. I take for an example the tentative layout which has been evolved for Brooks School at North Andover, Mass. The plans represent the more recent steps toward the consummation of a final plan. Doubt-

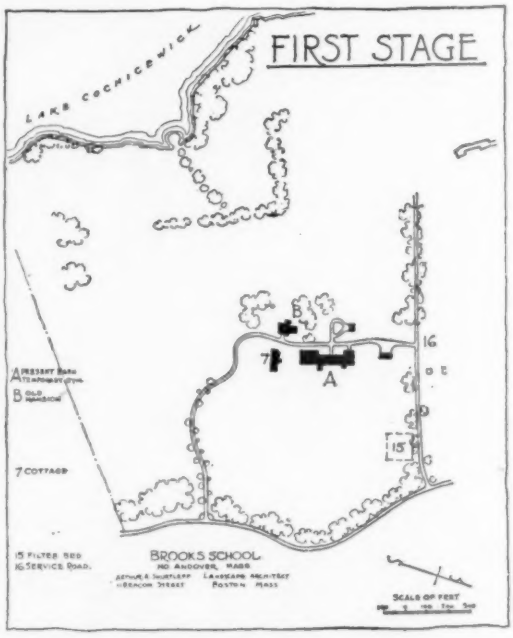
less, further changes will be required, but if so, they will be governed doubtless by the following considerations and studies.

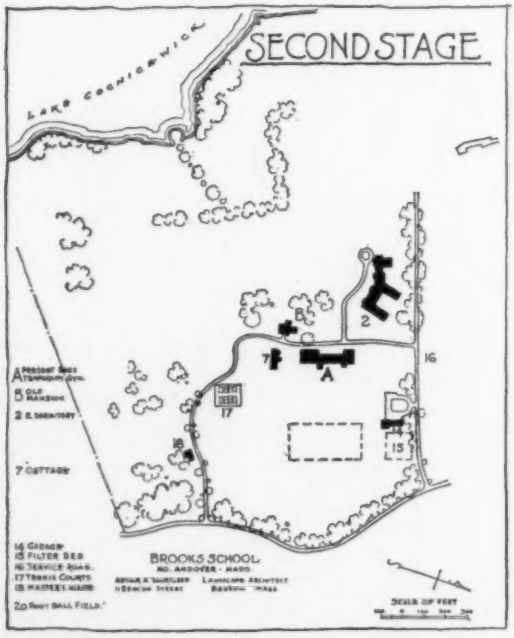
Principal Features of the Brooks School Plan

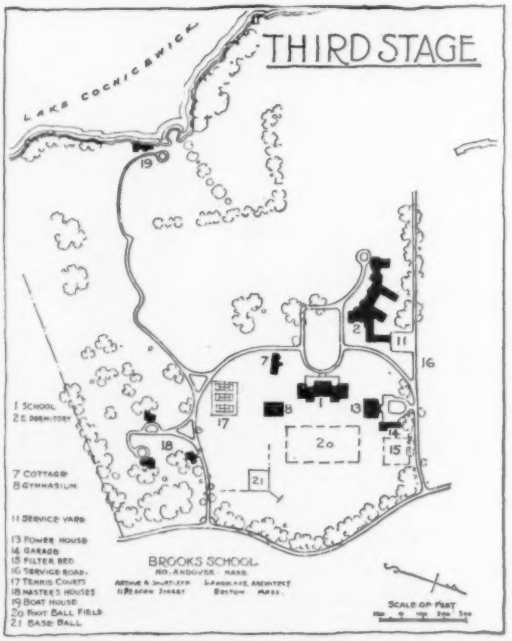
a. The site as a whole is recommended by good exposure to the sun and wind, reasonable nearness to main railroad and highway routes, isolation from large cities and towns, a good water-supply and electric service, and satisfactory opportunities for sewage disposal and surface water drainage. Ground sufficiently level for building purposes and commanding good views was available. Buildings suitable for temporary quarters were at hand.

b. Tentative studies were made of the probable building sites and of the contour of the ground in relation to surface water drainage to sanitary sewers, to the location of athletic fields, roads,









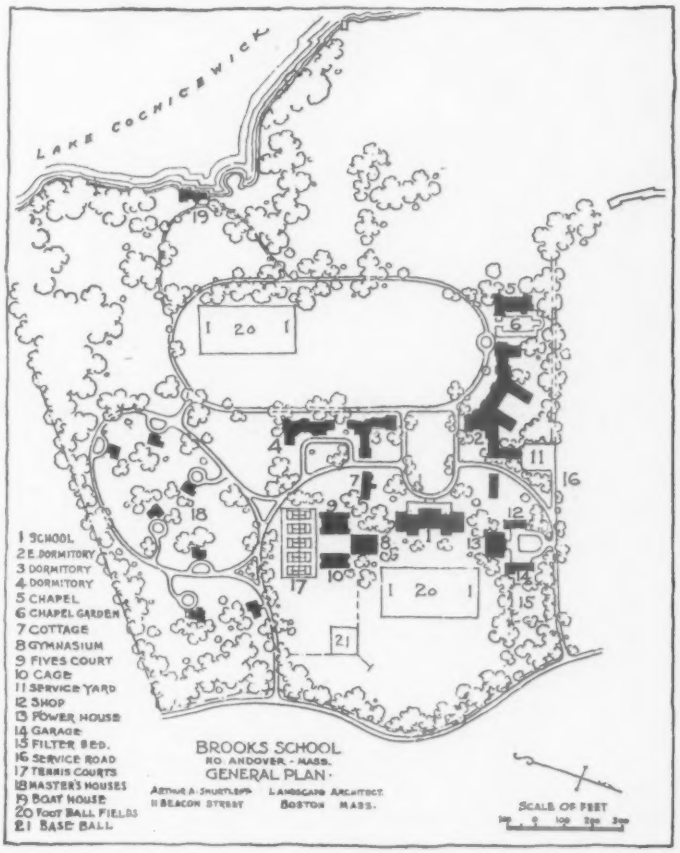
service departments, to general approach, to the desirable winds, to the direction of the sun, especially in winter, to views, and to the position and the contour of adjacent public property. (See the survey, page 116.)

c. These studies were tried out on the ground by staking, and many desirable changes were made after consulting the committees and advisors. The feasibility of utilizing some of the existing buildings and roads as a part of an ultimate scheme was established. (See plans of the first stage of development, which was not, however, closely followed in some particulars.)

d. The service approach to the kitchens of the larger dormitory was arranged to function with the sites for future garages, the shops, and other service departments, to which proximity to the drainage field was unobjectionable.

e. The site for the central school building was chosen with consideration of the position proposed for the dormitories and dining-hall, and with regard to the size, height and dominating nature of the building itself. (See second stage of development plan.)

f. The position of the athletic fields was determined in part by the shape of the ground and the exposure to the wind and sun, and in part by the position of the gymnasium. The gymnasium site was determined by relation to views which this building ought not to hide, and with regard to the best approach to the lake and to the boathouse (the latter being sheltered from the prevailing winds and placed near water sufficiently deep).



g. The position of the heating plant in the basement of the school was determined by the ground-slopes which would assist the return of condensed steam, the position of the service road upon which fuel could be brought in, and the direction in which the prevailing wind would carry off smoke.

h. The dormitories were placed with regard to the sunlight available in the several exposures, and with consideration of approach to and from all parts of the grounds. The chapel site was chosen for quiet, distinguished position and accessibility.

i. Detached houses for masters were placed in a group upon a separate roadway with good outlooks from high ground and within easy walking distance of the school group, near the utilities and the athletic fields.

j. Plantations of hardy trees and shrubbery were planned to support the general mass composition of the buildings and the approaches, to afford protection from the wind, to act as screens, to give shade, and to provide pleasant foliage effects at all seasons.

Evolution and Modification of the Preliminary Studies

The plans showing the first, second and third stages were prepared to indicate the probable sequence of the work, including planting, road construction, and the erection of buildings. The purpose of making these forecasts was to size up the probable appearance of the work as it progressed, to control the physical progress, and to estimate costs. Up to the present some departures have been made in the first and second stages. Actual experience on the ground, though it will modify the stages and some of the sites, will not of course eliminate the controlling factors and the consideration noted above. At the start the importance of cooperation among all interested persons and groups was fully realized. The studies were made by the landscape architect in consultation with the headmaster, the treasurer, the many members of the grounds committee, and the engineers. No pains were spared to view the problem from every angle and to study it on the ground as well as at conferences upon the surveys.

Throughout all this work constant attention

was given to the appearance of the result, both as far as structures and utilities are concerned and with regard to the contour of the ground and the position of existing fine trees and proposed extensive tree plantings. The direction of good views of the lake and of the distant countryside was also kept constantly in mind. Every group of factors, though considered separately, was of course sized up in its relation to all other groups. An attempt was made to arrange the stages of development in a manner to present an attractive appearance at the end of each stage so that no long periods of confusion or obviously incompleted work would result.

Quadrangular Grouping of Buildings

The resulting tentative plan is built up of a series of quadrangles complete or nearly complete. The main quadrangle opposite the school building is open toward the view. The second quadrangle bounded by the dormitories and the gymnasium opens toward the south and toward the masters' houses. The group on the west composes with the rear of the school building, the façade of which is to compose with the gymnasium and flanking buildings. The gymnasium itself is arranged to group with the fives court and with the cage adjacent to which the tennis courts are placed.

The worth-while savings which the quadrangular grouping of buildings accomplishes are briefly these: The buildings shelter one another from the elements without blanketing or overshadowing and the interspaces are also sheltered; the buildings supplement one another architecturally in such a way that the effect of one is enhanced by the presence of all the others. Systems of approach by paths and roadways are greatly simplified in such quadrangles. In the long run the saving in costs for the installation and the maintenance of utilities is one of the strongest arguments for a group of quadrangles. The pleasantness of the buildings themselves and the unity of the whole composition is vastly enhanced by this form of alignment. From the earliest times quadrangles have been built for these reasons, but in our own time, with the use of centralized heating plants and with the need for privacy in the era of motor vehicles, the use of quadrangular formations is of increased importance.

The scale of the plan and the number of buildings will indicate that the number of boys to be accommodated is in the vicinity of two hundred at a maximum. No description is attempted here of the architectural treatment of the buildings, which are to be in the Colonial style, and of the intimate relationship between the general plan and the approaches to the buildings as well as to the interior arrangement of each structure. Evidently, the interior planning of the buildings cannot be separated from the planning of the ground. Consequently, close cooperation of the landscape architect, the architect, and the engineer is essential at all stages of the work.

The bird's-eye view of the school showing the building group completed is tentative, but gives an impression of the relation of the sites to the topography.

THE ORANGE HIGH SCHOOL, ORANGE, N. J.

A High-School Building Which Reflects the Dignity of Its Community

BY ERNEST SIBLEY

ARCHITECT, PALISADE, N. J.

THE pride and dignity of the fine old town of Orange, N. J., are interpreted and reflected in its leading educational institution.

Faced with the problem of planning a large building for a restricted site, the architect's ingenuity was severely taxed. The result is a design somewhat formal, perhaps, but softened by proportion, detail, window treatment, and color scheme.

After all, is not advanced education a thing of pride and dignity, and, if so, why should this not be expressed in the architecture which houses it?

This building is of Harvard brick, with white marble aggregate cut cast stone trim, which softens in time to the tone of the old marble of Colonial days.

Possibly the most unique feature of the building is the elimination of ordinary classroom windows on the street fronts. Confining the main building to two stories in height, the two important end pavilions are tied together with a third story in the background, at the back of the front corridor. The additional light needed for the front classrooms and library is taken from overhead, and concealed by the balustrade.

Auditorium Planned for Community Meetings

There being a great demand in the Oranges for community meeting places, the auditorium was located on the corner of the plot, at the intersection of two streets. A spacious lobby permits the comfortable and speedy gathering and dispersion of the crowds. Retiring-rooms, check-rooms and ticket booth, and on the side street an entrance from a motor driveway, have been provided.

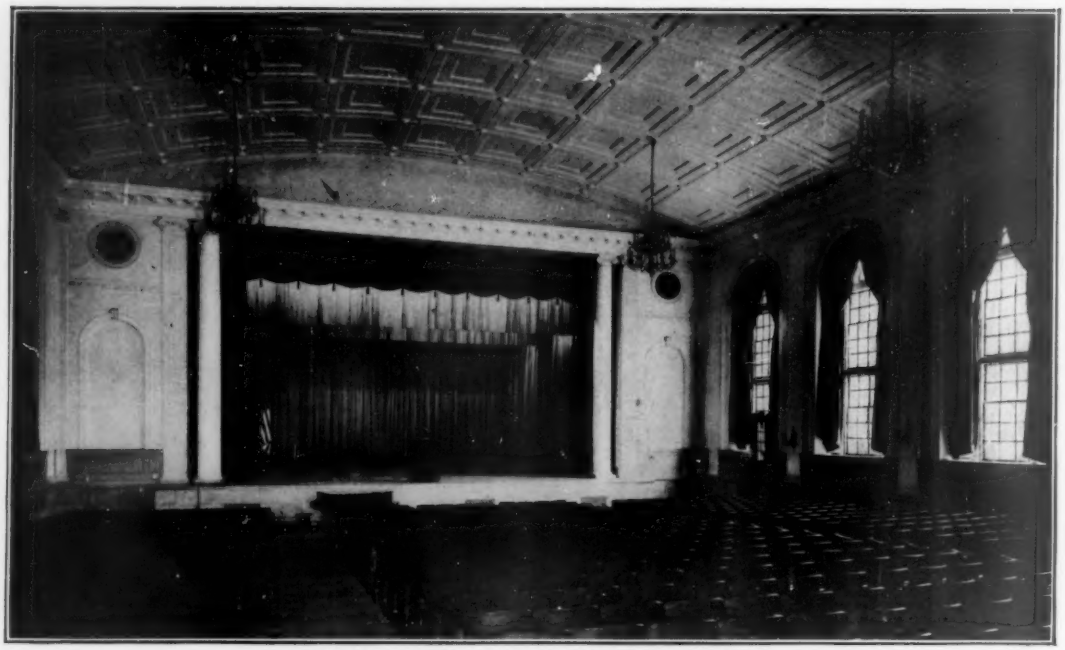
The auditorium seats about 1,400, and the acoustics are perfect in the most remote parts of the room. Its architectural beauty is greatly enhanced by the richness of the old-blue and gold hangings, the low ivory-toned wainscot, and the walnut seating, upholstered in blue leather.

The stage is exceptionally large, is equipped with old-gold cyclorama and back-drop curtains, with a series of valances, spotlights, dimmers, etc. It opens up into the second-floor corridor, providing seating in bleachers, for the 400 members of the "Chorus of the Oranges." These bleachers let down into a storage room under the stage, when not in use.

Above the lobby on the second floor is a music room with stage, isolated from the classrooms and so located that it may be used by the public for small musicals or gatherings, without entering the main part of the school.

The Double Gymnasium

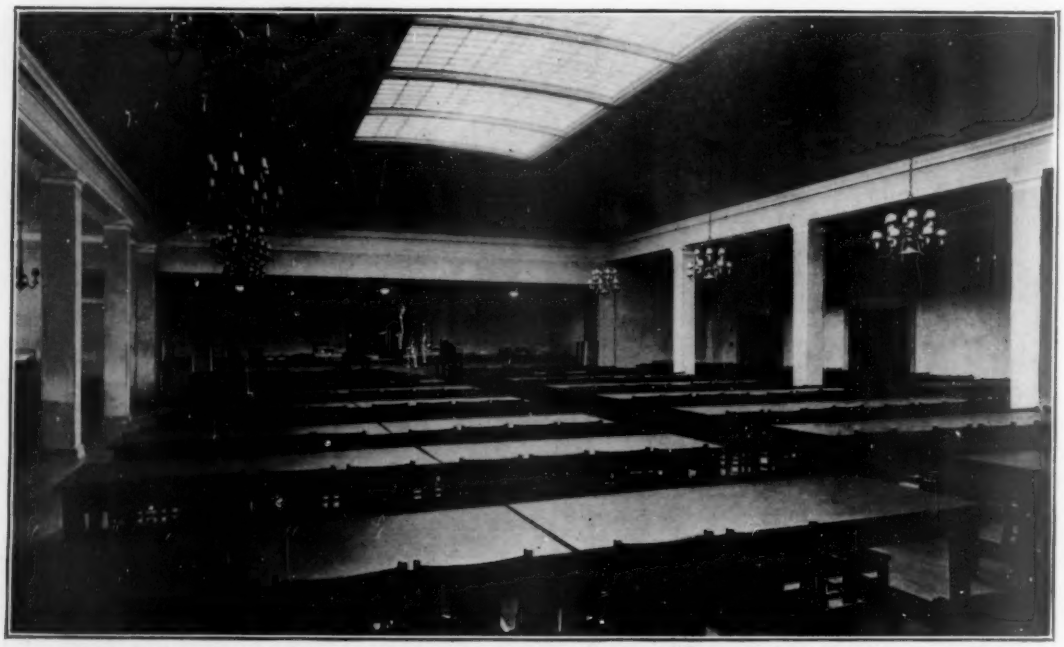
In the left wing of the building is the double gymnasium, separated by sectionfold partitions



AUDITORIUM OF THE ORANGE HIGH SCHOOL

folding back into a recess in the gallery. The clear floor space of the double gymnasium opened, is 50 feet x 160 feet in area. The gymnasium is equipped so that a basket-ball court in the center can be used for "big games," and the collapsible bleachers, stored under the gallery, will accommodate 1,200 spectators.

The gymnasium floor is at ground level, owing to the contour of the ground, and the lockers, showers, etc., are back of the gallery and lighted from the court. There are also additional locker space, men teachers' room, bicycle room, receiving and general supply rooms, in this section of the basement.



WHEN THE SERVICE SECTION OF THE CAFETERIA OF THE ORANGE HIGH SCHOOL IS CLOSED, THE ROOM IS USED FOR A STUDY HALL

Combined Cafeteria and Study Hall

Above the gymnasium are located, first, the science department, with private corridor, and second, a combination cafeteria and study hall. Excepting during the luncheon periods, doors folding into pockets at the front of the service counter, isolate the noise of the service portion, and the room then becomes a delightful study hall.

Across the central portion of the front of the building are the city school and the high school executive offices. Between these is the Board of Education room, with fireplace. All these offices are beautifully finished and furnished, not extravagantly, but in excellent taste and in keeping with the character of the building and the administrative staff.

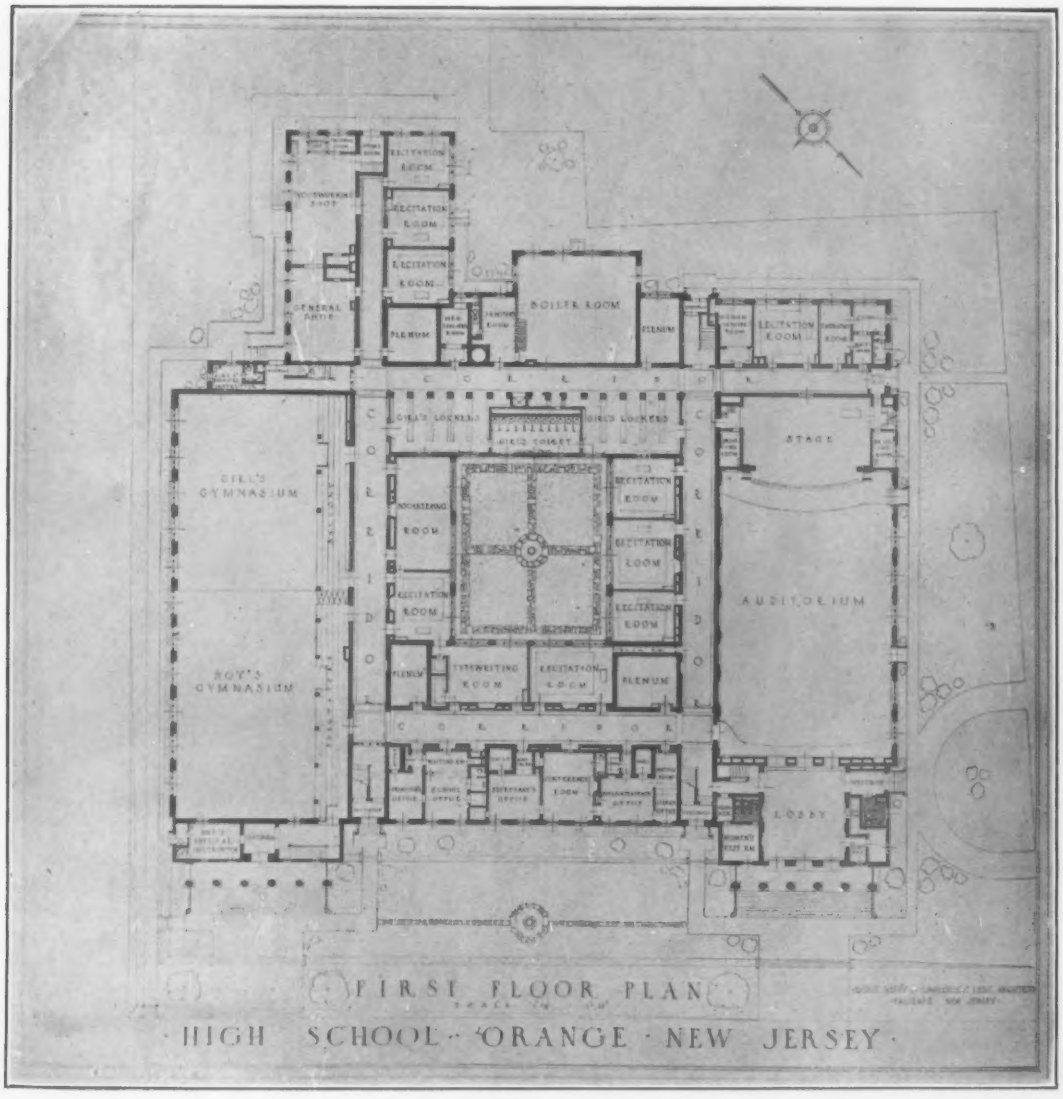
Heating and Ventilating System

The heating is by the "Split System." The ventilating system is so arranged that the air throughout the entire building can be recirculated through a by-pass chamber over the third floor corridor for rapid warming of all rooms before school is opened on cold mornings, and for recirculation out of school hours.

Messrs. Strayer and Engelhardt of Teachers College, Columbia University, were retained by the Board of Education, as educational advisors, and rendered valuable asistance, as did R. Burton Patrick, Superintendent of Schools.

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Asbestos Curtains—Lee Lash Studios.
Auditorium Seats—Heywood-Wakefield Co.
Moving Picture Machine—National Theatre Supply Co.
Moving Picture Screen—Raven Screen Corp.



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ST. LOUIS, MO., International Life Building
SAN FRANCISCO, CAL., Phelan Building
KANSAS CITY, MO., Finance Building
CHICAGO, ILL., Union Trust Building

PRODUCTS

Genasco Standard Trinidad Lake Roofing Asphalt, Asphalt Saturated Felt, Roll Roofings (Smooth and Slate Surface), Latite Shingles, Waterproofing Asphalt (Solid and Liquid), Waterproofing Felts and Fabrics, Asphalt Mastic, Industrial Paint, Acid-proof Paint, "Curcrete," an asphalt emulsion for curing concrete roof decks. Also Refined Trinidad Lake Asphalt, Trinidad Lake Asphalt Cement, Bermudez Road Asphalt, Refined Bermudez Lake Asphalt, Bermudez Lake Asphalt Cement, Gilsonite; Genasco Tile Cement, Asphalt Pipe Coating, Asphalt Fiber Coating, Roof Coating, Battery Paint, Battery Seal Asphalt, Asphalt Putty, Deadening Felt, Insulating Paper, Red Sheathing Paper, Stringed Felt, Wall Lining, Sealbac Shingles (individual and strip), and Elastic Boiler Cement.

Reg. U. S. Pat. Off.
TRADE MARKS

SPECIFICATIONS FOR GENASCO STANDARD TRINIDAD LAKE ASPHALT BUILT-UP ROOF OVER BOARDS

Materials—The waterproofing factor shall be Genasco Trinidad Lake Roofing Asphalt, heated to a temperature of approximately 400 to 500 degrees F., uniformly mopped, using approximately 30 pounds per 100 square feet.

The reinforcing factor shall be Genasco All-Rag Standard Felt and Genasco All-Rag Extra Heavy Felt 32 inches wide. The Genasco Standard Felt shall weigh approximately 15 pounds per 100 square feet and the Genasco Extra Heavy Felt shall weigh approximately 30 pounds per 100 square feet.

Application—1st—One layer of Genasco Extra Heavy Felt shall be laid on the roof boards, lapping each sheet 2 inches and nailing through the laps and longitudinal center with broad head roofing nails, spaced 12 inches apart.

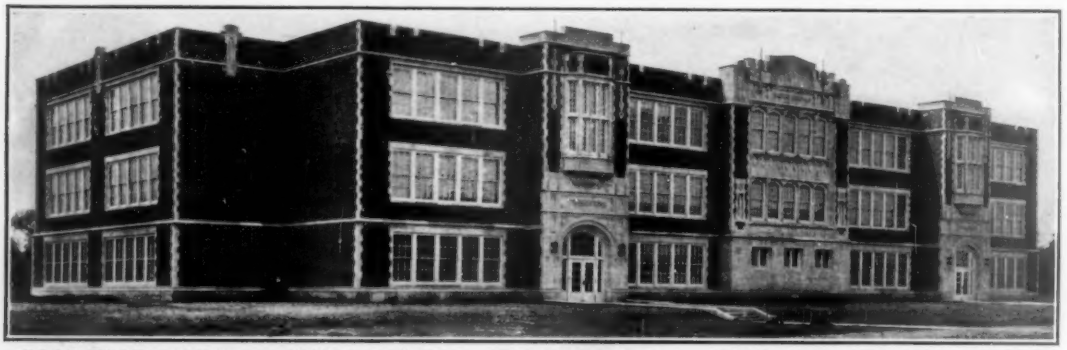
2d—Over the Genasco Extra Heavy Felt thus laid, mop down approximately 30 pounds of Genasco Trinidad Lake Roofing Asphalt per square, into which, while hot, apply two layer of Genasco Standard Felt, lapping each sheet 17 inches and mopping the full width of the lap, using approximately 30 pounds of Genasco Trinidad Lake Roofing Asphalt per square.

3d—Over the Genasco Felts thus laid, mop down approximately 30 pounds of Genasco Trinidad Lake Roofing Asphalt per square, finishing the roof in a uniform and workmanlike manner.

APPROXIMATE QUANTITIES OF MATERIAL FOR 100 SQUARE FEET OF ROOF SURFACE

1 layer Genasco Extra Heavy Felt	30 lbs.
2 layers Genasco Standard Felt	30 lbs.
3 layers Genasco Trinidad Lake Roofing Asphalt	90 lbs.
	150 lbs.

This roof contains 122 pounds of waterproofing factor and 28 pounds of reinforcing factor, or 81% waterproofing factor and 19% reinforcing factor.



ROOSEVELT SCHOOL, WICHITA, KANSAS, PROTECTED BY A GENASCO STANDARD TRINIDAD BUILT-UP ROOF

PARENTAL SCHOOL, NEW YORK CITY, THE FLOORS OF WHICH ARE COVERED WITH GENASCO ASPHALT MASTIC

SPECIFICATIONS FOR GENASCO ASPHALT MASTIC FLOORS

Base—The concrete or other base shall be prepared ready to receive the mastic surfacing . . . inches below and parallel to the final finished floor grade with proper slopes established to take care of any required drainage. (If the floor is to be laid over wood, first lay one thickness of Genasco Wall Lining. Flash at all posts, walls, etc., with a paint coat of Genasco Priming Paint.)

Materials—The block shall be a Genasco Asphalt mastic as produced by THE BARBER ASPHALT COMPANY. The flux shall be Native Trinidad Lake Asphalt of proper penetration for the work involved. The sand shall be fairly sharp, free from loam or any foreign matter of vegetable origin, and shall be well graded from coarse to fine, all passing a 10-mesh sieve and not over 3% passing a 200-mesh sieve. The coarse aggregate shall be a gravel, crushed trap rock, crushed gravel or other crushed sound stone, all passing a ½-inch screen and retained on a 10-mesh sieve.

A formula giving the proportions of mastic block, flux, sand and coarse aggregate for the proposed mixture to be submitted to the engineer or architect, together with a sample of the sand and coarse aggregate which the contractor proposes to use.

Construction—On the base, as above specified, lay a Genasco Asphalt Mastic Floor, not less than . . . inches in thickness, laid in . . . layers. The Genasco Asphalt Block shall be brought to the site of the work, broken and melted in suitable kettles, together with the proper amount of flux, sand and coarse aggregate (the two latter previously dried and heated) in proportions satisfactory to the engineer or architect. THE BARBER ASPHALT COMPANY will give its opinion, if requested, as to formulæ for mastic mixes for various conditions, provided samples of the aggregate to be used for the work are submitted for examination.

After sufficient heating and stirring, the mixture shall be spread on the established base to a uniform thickness of . . . inches and worked under wooden floats until it is free from voids. A half-and-half mix of fine sand and portland cement shall then be sprinkled on the floor and the surface rubbed smooth.

The mastic mixture is to be laid in approximately 6-foot strips. In making joints the hot mastic shall overlap the preceding strip about 4 inches so that the edge of the cold strip will become soft, thus allowing the finisher to make a perfect joint after the surplus material spread over the cold strip has been cut away.

Note: Thickness of mastic to be according to conditions and service to which the floor is subjected. Where acid conditions exist, Genasco Acid-Proof Mastic Block and silicious aggregate must be used. Where the mastic is to be more than 1 inch thick, it is to be applied in two layers of . . . inches, each with joints in top layer so made as not to coincide with the joints in the bottom layer. Top layer only is to be rubbed with the sand-portland cement mix.

PATRICK HENRY PUBLIC SCHOOL, CLEVELAND, OHIO—8000 SQUARE FEET OF GENASCO ASPHALT MASTIC USED OVER THE COAL VAULTS

ERASMUS HALL HIGH SCHOOL, BROOKLYN, N. Y., PROTECTED BY GENASCO BUILT-UP ROOFING MATERIALS; GENASCO ASPHALT MASTIC USED ON STAIRS, STAIR LANDINGS AND FIRE TOWER EXITS

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SWAGED SECTIONAL FLAGPOLES fabricated of Copper Bearing tubular steel pipe in three weights for ground setting: Light Pattern, Heavy Pattern and Extra Heavy Pattern; and fabricated in two weights for roof setting: Heavy Type and Extra Heavy Type.

CONTINUOUS TAPERED FLAGPOLES made in either steel or bronze with smooth uninterrupted exterior surface, tapered conically or with entasis; resemble in contour the appearance of wooden flagpoles and have no visible joints throughout.

SWAGED SECTIONAL FLAGPOLES

Our swaged sectional poles are fabricated by joining consecutive diminishing diameters of new mill run of full weight standard, open-hearth, lap-welded, Copper Bearing steel, tested pipe with the joints either of the **shop** type (swaged, telescoped and shrunk) or of the **field** type (swaged and self-aligning). All joints are constructed without the use of bolts, pins, rivets, screw couplings or lead calking. Poles of this type are designed to withstand wind stresses up to 90 miles per hour with a conservative bending resistance. These poles are shipped in one or more knocked down sections and assembled on the ground by means of the field joints. Each section is made to suit car lengths which allows transportation at a minimum rate for less than carload lots and each section may contain two or more pieces to produce the proper reduction. At the erection site the flagpole erector merely pushes or telescopes the sections together and after erection makes the field joints airtight and watertight by calking metal to metal with only an ordinary hammer and calking chisel. Inexperienced men may, in a minimum length of time, accomplish the erection of our swaged sectional flagpoles.

TABLE OF DIMENSIONS FOR SWAGED SECTIONAL FLAGPOLES FOR GROUND SETTING OR ROOF SETTING

| REMARKS | FLAGPOLES for ROOF SETTING | | | | | | | | | | | | | | | | FLAGPOLES for GROUND SETTING | | | | | | | | | | | | | | | |

CONTINUOUS TAPERED FLAGPOLES

Especially designed for memorials, monuments and buildings of exceptional architectural value. Continuous Tapered Flagpoles are of an entirely different construction from the swaged sectional poles and are more costly. These poles are produced in either steel or bronze and may be tapered conically or with entasis. They have a smooth uninterrupted exterior surface throughout without visible joints or offsets and resemble in contour the obsolete wood flagpoles. Continuous Tapered Poles are not carried in stock and are made to order only. The lower one-third of the visible height of these poles is cylindrical, the diameter of which corresponds to a standard pipe size and the tapered section is confined to the remaining visible height. When poles of this type are used as flagpole monuments or memorials the Architect of the project usually designs a special bronze base and special stone work. We gladly offer our services to Architects by assisting them in properly designing the necessary foundation so that no damage may result from vibration, water or by the water freezing. Continuous Tapered Flagpoles, regardless of length, are usually shipped in one piece each, without field joints, but where shipping and handling will not permit the poles are shipped in two sections each and assembled at the erection site by means of a special field joint. This assembling, however, cannot be accomplished by inexperienced men and we will not ship Continuous Tapered poles in sections unless the assembling in the field is accomplished by our own men. This tends to enhance the cost slightly but insures the purchaser a first class installation which might be marred through the neglect and inexperience of others doing this work.

Further information regarding Continuous Tapered Flagpoles will be mailed to those interested upon application.

INSTALLATIONS

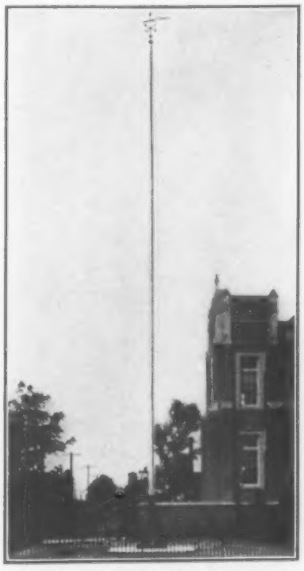
University of Kansas Stadium, Lawrence, Kansas
University of Michigan Museum, Ann Arbor, Michigan
University of North Carolina Stadium, Chapel Hill, N. C.
Mercersburg Academy, Mercersburg, Pa.
Font Bonne College, St. Louis, Mo.
Luther College Gymnasium, Decorah, Iowa
University of Rochester Hospital, Rochester, N. Y.
Concordia Teachers College, River Forest, Ill.
State Normal School, Salisbury, Md.
School of Mines, Rapid City, South Dakota
Philadelphia Public Schools (over 185 installations)

CATALOG

Our General Catalog and Architects' Guide containing full information regarding our flagpole products gladly mailed upon request.

90 X 99-FT. HEAVY PATTERN SWAGED SECTIONAL FLAGPOLE

One of the 185 manufactured and erected for the Philadelphia School Board.



60-FT. ABOVE GRADE CONTINUOUS TAPERED POLE

7⅝-in. butt x 3½-in. top. Parochial School, Riverside, N. J.

80-FT OVER-ALL CONTINUOUS TAPERED POLE

14-in. butt x 5-in. top. Massachusetts Mutual Life Insurance Building, Springfield, Mass.

TRUSCON STEEL COMPANY

YOUNGSTOWN, OHIO, U. S. A.

SALES AND ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

Truscon manufactures a complete line of permanent building products for Schools. All types of Steel Windows, Steel Joists, Reinforcing Steel for fireproof floors, Steel-deck Roofs (insulated and waterproofed), Metal Lath for Safety, beautiful and permanent plaster effects.

TRUSCON DONOVAN AWNING TYPE WINDOWS

The Donovan Awning Type Window is manufactured in steel by the Truscon Steel Company at Youngstown, Ohio. Information about the Donovan Awning Type Window for Wood Sash may be obtained from the Universal Sales Company, 1916 Broadway, Oakland, California.

FRESH AIR WITHOUT DRAFTS—SUNLIGHT WITHOUT GLARE

The Truscon-built Donovan Awning Type Steel Window was especially developed for use in schools. It provides natural ventilation with absolute local control and complete avoidance of drafts. The method of attaching and operating window shades is simple. When the shades are drawn they shut out injurious direct sun rays. The resulting light conditions are ideal for class rooms and preserve the eyesight of the growing nation.

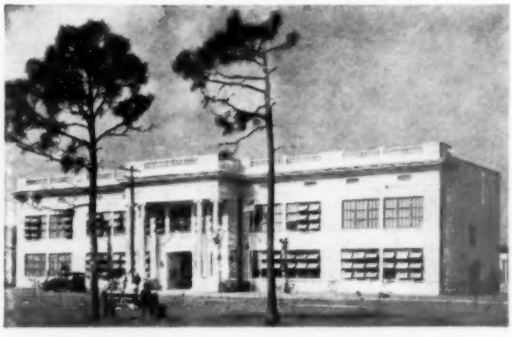
Each of the illustrated combinations has its own advantage with innumerable variations of ventilation control. Operation is simple. Moving parts do not show when ventilators are closed and no part protrudes into the room.

A FEW DISTINGUISHING FEATURES

Simple in construction, yet strong and durable. It is so perfectly balanced that a child can open or close all sashes in one simple motion. It eliminates the window-pole as well as heavy hand-lifting and pulling. No sticking or binding. Can be cleaned easily and quickly from the inside. May be used as an awning, admitting light and air, yet affording perfect sun protection, because the shades are attached separately to each sash. Assures better ventilated rooms and more healthful living conditions. Fire resisting qualities because it is made of steel. Permits use of large areas of glass harmonizing with the architectural design. Stocks of windows in suitable standard sizes are available. Can be combined for large openings.

STOCK UNITS

WEST WARWICK HIGH SCHOOL, APPONAUG, R. I.
(Harry A. Slocomb, Architect)



MIRAMAR SCHOOL, MIAMI, FLA.
(Mayer & Dobson, Architects)

TRUSCON

TWENTY-FIVE YEARS OF PIONEERING & LEADERSHIP

TRUSCON is an institution of national scope, the largest company of its kind in the world, manufacturing a complete line of steel products for permanent construction.

Truscon combines careful production methods with accuracy, quality and sound engineering to insure the utmost value and efficiency.

Daylighting and Ventilating Schools

DOUBLE-HUNG WINDOWS

The Model "A" Solid Steel Double-Hung Windows give unusual refinement in architectural and structural design. Massive strength and rigidity, weather-tightness as well as beauty are outstanding qualities.

DONOVAN AWNING TYPE WINDOWS

For sunlight without glare and maximum ventilation without draft. Simple in construction, strong and durable. They are easy to operate, no poles, chains or hooks required. Permit use of large areas of glass harmonizing with the architectural design.

ARCHITECTURAL PROJECTED WINDOWS

The Truscon Architectural Projected Window is one of the most popular and practical types for schools. The ventilators operate entirely outside the frames without interference with shades. A large variety of standard sizes of these windows makes it possible to meet practically every architectural treatment.

STANDARD PROJECTED WINDOWS

This type of window operates the same as the Architectural Type but is made for use in rear elevations of the school given over to manual training, forge shops, machine shops, etc. Also practical in pent houses, boiler rooms, etc.

PRODUCTS OF THE TRUSCON LABORATORIES

Truscon's Laboratory Products include Waterproofings, Floor Hardeners, Steel Sash Putty, Plaster Bond, Technical Paints, Varnishes, Enamels, etc. All of these products play an important part in school construction and maintenance.

Firesafe and Permanent Schools

REINFORCED CONCRETE FLOOR SYSTEMS

Truscon has developed several systems of reinforced concrete construction for schools. Locktyle is a permanent pan construction of economy and stability. Wydespan offers particular removable form economy under certain conditions and ordinary Removable Floreforms have certain properties that make their use advisable under still other conditions. Truscon Kahn and Rib Bars and Improved Column Hooping meet every requirement of economical concrete reinforcement.

STEEL JOIST CONSTRUCTION

For school floors of moderate span, Truscon Steel Joist Floor Construction is favored.

STEELDECK ROOFS

Truscon "I-Plates" offer a major solution to the problem of economical roofs for schools. Particularly over Auditoriums and Gymnasiums the Steeldeck Roofs offer big savings because of light weight. Radiation and fuel consumption are markedly reduced through the insulation on these roofs.

TRADE SCHOOL BUILDINGS

Many School Architects and School Boards are taking advantage of Truscon Standard Buildings for trade school units. Quickly erected, economical in cost, always salvageable, they are ideal buildings used for manual training trades purposes.

TRUSCON HY-RIB AND PLASTER BASES

¾" Hy-Rib is used for balcony forms and reinforcement, stair rail forms and reinforcement, pipe trench cover slabs, etc. ⅜" Hy-Rib for partitions furring, etc. A-Lath is the most economical plaster base known to the plastering craft.

AVAIL YOURSELF OF TRUSCON SERVICE. IT INVOLVES NO OBLIGATION

JOSEPH A. VOGEL COMPANY

WILMINGTON, DELAWARE ST. LOUIS, MISSOURI

VOGEL Number Ten seat-action water closet combination for schools, factories, comfort stations, etc. Made of the finest materials and workmanship throughout—a product that will stand-up under hard usage.

THE TANK MAY BE CONCEALED BACK OF THE WALL IF SO DESIRED

A DURABLE POSITIVE ACTING CLOSET

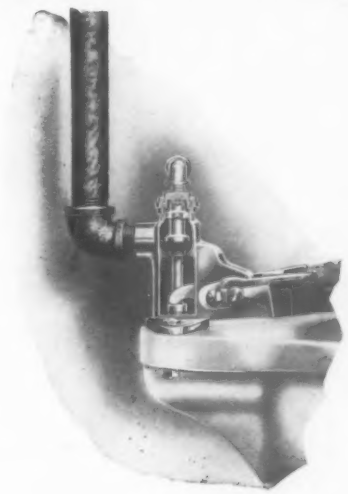
The water closets in a school building usually receive more use and abuse than any other fixture.

We believe the VOGEL Number Ten to be the strongest and most durable water closet outfit ever made.

The tank and flush pipe are practically indestructible. The valve is heavily constructed throughout of good quality material and attached to the bowl by a very strong connection. The operating lever and flange are of heavy bronze and will give years of service with very little wear. The closet seat is of durable make and is finely finished. The seat brace is stronger than we have made heretofore and it will stand-up indefinitely under hard usage. The bowl is made of vitreous china.

VOGEL Number Ten water closets can be placed in roughs 16 inches from wall to center of waste outlet. May be set-in to 12½ inches by offsetting flush pipe.

VOGEL TROUBLE-PROOF MECHANICAL FLUSH VALVE



When the closet seat is depressed the supply valve packing is drawn down from the top supply valve seat, and the flush valve packing is brought into contact with the flush valve seat, allowing water to enter the tank through the flush pipe. When the pressure of the water and air in the tank becomes equalized with the service pressure, no more water enters the fixture. This water is held in readiness for the release of the seat.

Upon releasing the seat, the rod which carries both the supply and flush valve pack is forced upward, closing the water supply at the inverted supply seat in the swivel at the top. The flush valve, by the same movement, is opened and a strong flush of water from the tank to the bowl ensues.

By depressing the closet seat the supply coupling at the top may be easily removed. Then by raising the closet seat to upright position the valve stem carrying both the supply and flush valve packings may easily be lifted out.

The flush valve is closed by the pressure of the water, insuring easy closing.

The VOGEL Number Ten water closet with its positive-acting flush valve eliminates waste of water and once it is installed you can forget all about it. Write today for our catalog; it will pay you to investigate.

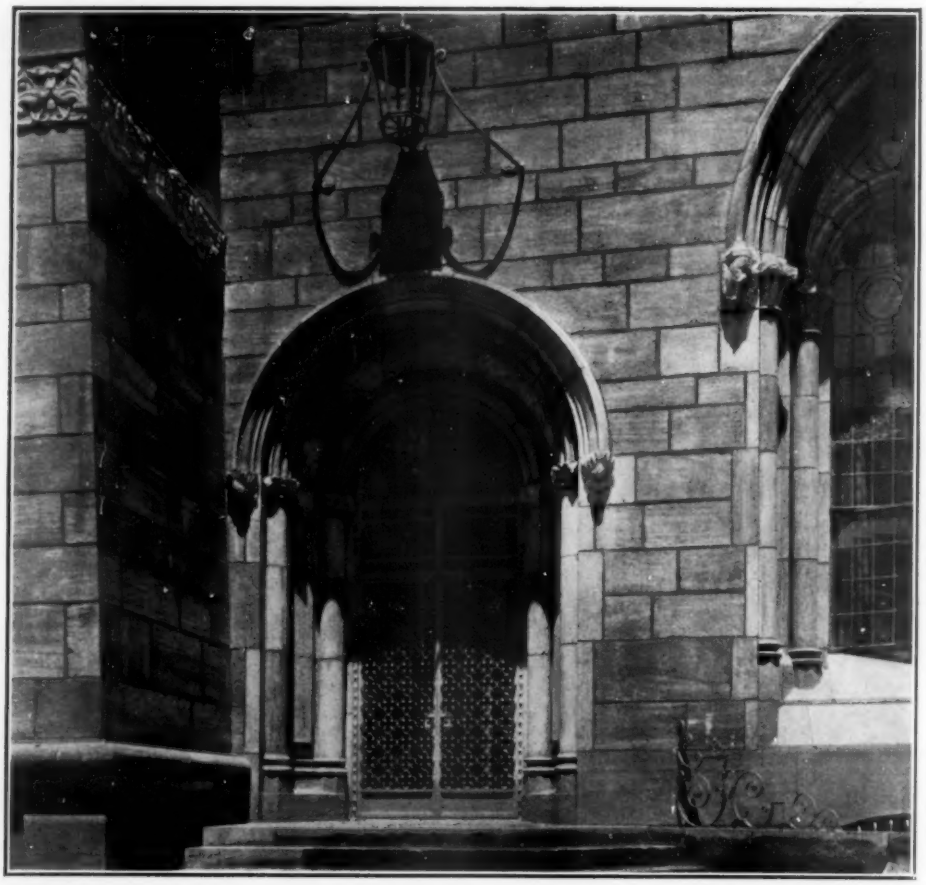
A sample valve was tested 150,000 operations without any appreciable wear.

All water drains out of the flush valve body so that in places such as school buildings where the fires are banked over the week-end, valves will not be damaged by frost.

THE ADLERHURST IRON CO.

Builders of Ornamental Iron

NEW HAVEN, CONNECTICUT



The Adlerhurst Iron Company are builders and designers of all styles of Architectural and Ornamental Iron Work. The following are some of the buildings in which we take special pride in showing the work that we have executed:

STERLING CHEMICAL LABORATORY
STERLING HALL OF MEDICINE
SAGE HALL OF FORESTRY
ARCHITECTURAL SCHOOL
YORK LIBRARY DORMITORY
D. K. E. FRATERNITY HOUSE
LAPHAM FIELD HOUSE
PEABODY MUSEUM
EDWIN McCLELLAND HALL DORMITORY
YALE THEATRE
ZETA PSI
BINGHAM
OLIN MEMORIAL LIBRARY

Our estimators will cheerfully consult with you on your individual needs.

ALBERENE STONE COMPANY

Quarriers and Manufacturers of Alberene Stone

Main Office: 153 West 23rd Street, NEW YORK

Quarries and Mills at Schuyler, Va.

BRANCHES

Boston, Newark, N. J., Philadelphia, Richmond, Va., Pittsburgh, Cleveland, Chicago

PRODUCTS (see also page 308)

Alberene Stone, a natural quarried stone, fabricated for the following purposes in school construction:

- Stair Treads and Landings
- Door and Window Sills
- Plinths, Trim, Wainscot
- Flooring and Base
- Toilet Partitions
- Urinals
- Shower Compartments
- Shower Dressing Rooms

PHYSICAL CHARACTERISTICS

Alberene is a natural quarried stone, blue-gray in color, non-stratified and free from cleavage lines, dense, uniform in texture and color, practically non-absorbent and non-staining, easily cleaned, flame resistant and fireproof. It is easily machined —tongued, grooved, slotted, bored or turned —without splitting or spalling.

SANITARY WORK

The outstanding superiorities of Alberene for toilets, urinals and showers are: (a), its non-absorbent, non-staining, easily cleanable qualities; (b), its easy fabrication by means of tongue-and-groove, bolted-and-cemented joints, in structures that are impervious and 100% sanitary; (c), its non-spalling, non-chipping surface.

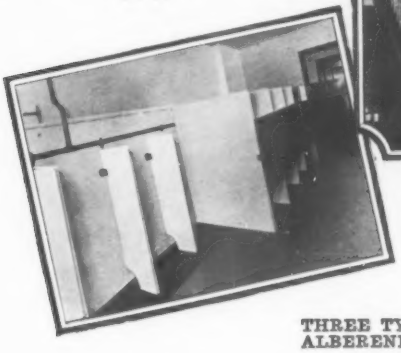
STAIR TREADS AND LANDINGS

A special grade of hard Alberene selected for these purposes has a "toothed" surface which never wears away and which is always non-slipping under all conditions. Its wearing qualities also are excellent, and it is absolutely fireproof.

THE MATTER OF "LIFE"

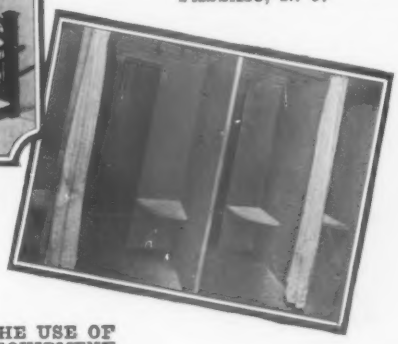
The limit of useful "life" of Alberene Stone has not yet been revealed in an experience of over 40 years. Barring accident, the moderate first cost of Alberene Stone equipment is the one and only cost—there are no after-costs.

TOILETS AND URINALS
HIGH SCHOOL, MONTCLAIR, N. J.



STAIR TREADS AND LANDINGS
HIGH SCHOOL, SOMERVILLE, N. J.

SHOWERS AND DRESSING ROOMS
MEMORIAL SCHOOL NO. 11, PASSAIC, N. J.



THREE TYPICAL EXAMPLES OF THE USE OF ALBERENE STONE IN SCHOOL EQUIPMENT

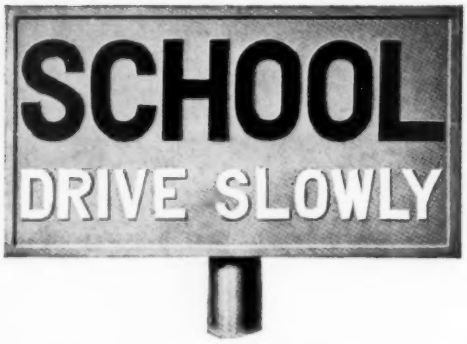
ALUMOYD SIGN AND SIGNAL CO.

255-59 E. 95th Street

CHICAGO, ILL.

Manufacturers

Exclusively of Municipal and Highway Traffic Signs and Roadpilot Reflecting Signals



ALUMOYD SCHOOL ZONE MARKERS

The proper marking of school zones and the control of traffic in the vicinity of schools and playgrounds are problems that concern every municipality and every school official. The lives of the children are valuable. There is great satisfaction in knowing that your city has provided the best possible means of making the streets near your schools safe for the children.

Alumoyd School Zone Markers are easy to read, well constructed, durable. They are made of solid alloyed aluminum—not merely coated with aluminum as are many so-called "aluminum" signs. Alumoyd signs are strong, weather-resisting, made to withstand abuse.

Any wording can be used, in raised letters. The size of the letters is determined by the wording required.

SPECIAL ADVANTAGES

1. Alumoyd Signs will not corrode, oxidize or show any effects of the weather for a long period of time.
2. They are tough, elastic metal castings which bend but do not easily break.
3. Each Alumoyd sign or signal is an individual, full-strength unit casting with raised letters, designed for the utmost practical strength.
4. The coloring employed on the letters is a special, exclusive, permanent material, guaranteed not to chip, crack or peel under the most adverse conditions.
5. All Alumoyd signs and signals are sold under a broad and liberal guarantee.

AMERICAN ABRASIVE METALS CO.

FERALUN—BRONZALUN—ALUMALUN

50 Church Street, New York City

BRANCH OFFICES

Buffalo, Erie County Bank Building
Boston, 136 Federal Street
Philadelphia, 1700 Walnut Street
Pittsburgh, Farmers Bank Building
Chicago, 111 W. Washington Street
San Francisco, 444 Market Street

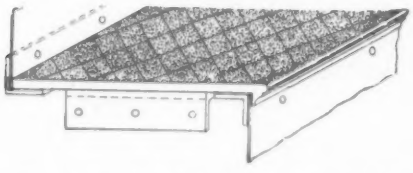
FERALUN
Anti-Slip Treads

Spell SAFETY in Your School

Boards of Education and School Architects all over the United States are finding that FERALUN Anti-Slip Treads are CUTTING REPLACEMENT COSTS and are successfully eliminating the hazard of SLIPPING and TRIPPING that is so dangerous on steps that are not protected against this serious evil.

The success of FERALUN Anti-Slip Treads is indicated by the fact that many of the principal school systems **specify** them for new building projects as well as for protecting stairways that have become worn through constant use. The illustrations show some of the styles of treads that are most frequently used:

STYLE "O"



Structural tread designed for new schools

STYLE "A"

With metal anchors for new concrete steps

STYLE "A"

Tread for old concrete steps

STYLE "A"

Rabbeted in tread for wood steps

STYLE "A"

Long lip tread for worn marble steps

FERALUN Treads are never slippery even when covered with soapy or oily liquids.

WRITE FOR DETAILS

THE AMERICAN SCHOOL AND UNIVERSITY

CHEMICAL TOILET CORPORATION

Office and Factory: SYRACUSE, N. Y.

Distributed by Plumbing Supply Jobbers

Convenient Warehouse Deliveries

SAN-EQUIP
Septic Tanks

Schools in unsewered areas may now receive complete sewage disposal service by use of the SAN-EQUIP Septic Tank.

The Septic process is a digestion of sewage by which most of the solids are eliminated and final disposal simplified. The treated sewage is usually disposed of by soil filter. Dry well or streams may be used for discharge when permissible.

Design—Follows findings of the U. S. Public Health Service, and is proved by years of experience.

Material—Copperoid iron, special rust-resisting, further rust-proofed with mineral asphalt enamel.

Durability—SAN-EQUIP Septics are protected by a heavy coating of mineral asphalt enamel, melted on inside and outside. They are unaffected by moisture, acids or soil. The perfecting of this process insures durability.

Capacity—Single home to large schools or communities.

SAN-EQUIP ADVANTAGES

They furnish important health protection.

Their simple design requires minimum attention.

Their light weight makes them easy to handle and install.

Each septic tank is a complete unit. There is no assembling of parts.

They are water-tight, unbreakable, with no seepage.

Prompt deliveries everywhere in the U. S.

Use our free advisory service for any special problems—location of tank, layout of filter bed or other plans for final disposal.

SAN-EQUIP
Waterless Toilets

SAN-EQUIP Waterless Toilets are recommended for school use wherever water supply is inadequate for a plumbing system or where special care is desirable to safeguard the water supply. The present model incorporates two important exclusive features which will commend the system to health authorities everywhere:

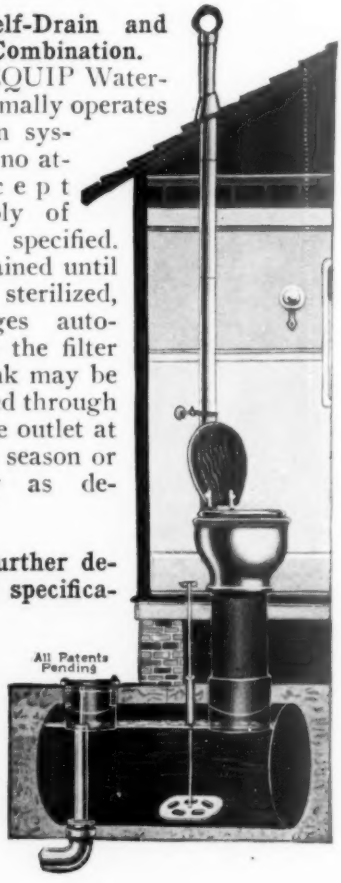
1. Liquid-Sealed Openings Eliminate Odors.

The drop-tube, agitator tube and manhole collar all extend below the liquid line, thus providing a liquid seal against odors more effective than any system of ventilation.

2. New Self-Drain and Drain Valve Combination.

The SAN-EQUIP Waterless Toilet normally operates as a self-drain system requiring no attention except monthly supply of chemical as specified. Sewage is retained until liquefied and sterilized, then discharges automatically into the filter pool. The tank may be entirely emptied through the drain valve outlet at the end of the season or as frequently as desired.

Write for further description and specifications.

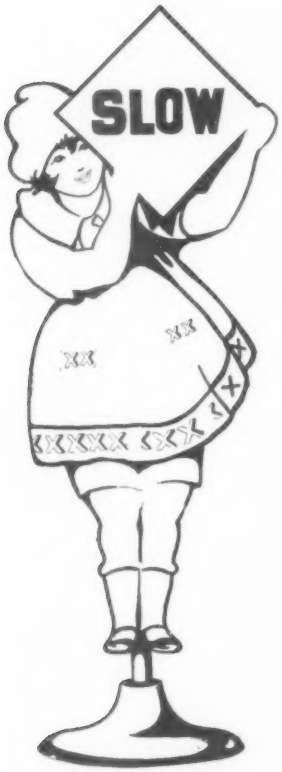


SAN-EQUIP WATERLESS TOILETS IMPROVED SELF-DRAIN LIQUID SEALED

ESSCO MANUFACTURING CO.

PEORIA, ILLINOIS

REPRESENTATIVES IN PRINCIPAL CITIES



"THE ESSCO GIRL"

Write for Your Catalog

FOR THE SAFETY OF MOTOR AND PEDESTRIAN TRAFFIC

Every year there is an alarming increase in the number of fatalities near Public and Grade Schools that can be eliminated.

THE ESSCO GIRL

Finished in three colors, 48 inches in height, life-like in appearance and very attractive, is set in the center of the approaching street or at the curb line, only during the times it is needed, before school in the morning, at noon, and after school is out.

ALSO MANUFACTURERS OF

SIGNS—

Electric, Plain, Reflector and See Thru.

SIGNALS—

Stop and Go, also Controlling Devices.

BEACONS—

Electric, Overhead and Post Mounted.

OVER ONE HUNDRED ITEMS EVERY ITEM GUARANTEED

THE GAMEWELL COMPANY

Fire and Police Signaling Systems

NEWTON UPPER FALLS, MASS.

BRANCH OFFICES

Boston, Mass., 1022 Commonwealth Avenue
New York, N. Y., 70 East 45th Street
Atlanta, Ga., Peters Building
San Francisco, Cal., 939 Larkin Street
Chicago, Ill., 417 So. Dearborn Street
Pittsburgh, Pa., 906 Keenan Building
Dallas, Tex., Praetorian Building
Denver, Colo., 1741 Arapahoe Street
Detroit, Mich., 1125 Pingree Avenue

FIRE ALARM SYSTEMS FOR SCHOOLS AND UNIVERSITIES

Fire alarm protection for schools presents an entirely different problem than for universities. For schools consisting of a single building a standard system is available. It is the Dualarm system, the simplest but most efficient system yet designed. For the university consisting of a group of buildings a survey must be made to determine the particular needs of the group. The system is then engineered according to the survey.

DUALARM SYSTEM FOR SCHOOLHOUSES

A schoolhouse system to be effective should do two things: (1) Empty the school of children. (2) Call the municipal fire department without pulling a separate box. The Dualarm now makes it possible to do both and in addition provides for a local drill signal controlled by the school principal, at a cost that is within reach of the average small school.

Typical Dualarm Specifications

The fire alarm system shall consist of a Gamewell Shunt Type Box with Shunt Pull Stations, to send the alarm to municipal fire headquarters a relay, contactor and vibrating bells (or horns) to sound a local alarm. No local battery is to be used.

The shunt type master box shall be a successive, non-interfering type that will be approved by the official in charge of the municipal fire alarm system. It shall be made so that the operating current for the shunt loop will be provided by the municipal fire alarm system.

The shunt pull station shall be a cast iron case containing a substantial knife switch arranged to keep the circuit normally closed. To operate the box simply pull down the handle and pull the hook. After the pull station has been operated it shall be automatically locked in such open position.

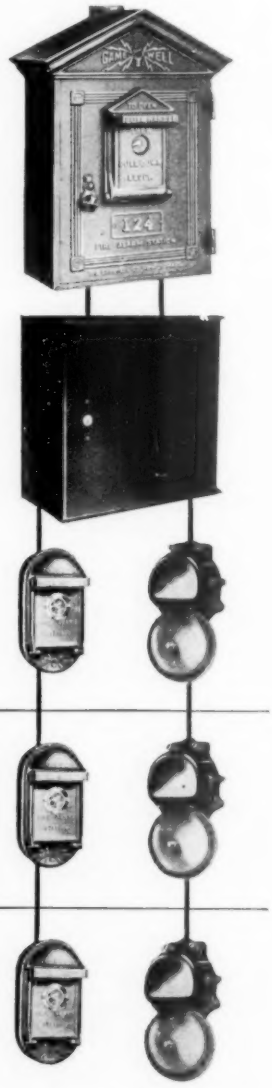
The contactor-relay set shall work in conjunction with the shunt type master box. When a pull station is operated the relay shall trip the master box and simultaneously energize the contactor, ringing the vibrating bells (or horns). The relay shall operate on a minimum line circuit of 65 milliamperes. The contactor shall be rated at 250 volts, 15-ampere intermittent operation and arranged to open both sides of the bell ringing circuit.

A starter button shall be provided for drill purposes to control the pick-up circuit of the contactor in place of the relay. The circuit arrangement shall prevent a drill signal from interfering with the operation of a shunt pull station and the transmission of an alarm to fire headquarters.

Vibrating bells shall be supplied which are provided with 6-in. saucer type bells and capable of being operated by the current supply available.

Horns shall be supplied in place of the vibrating bells, if a distinctive sound is desired for the interior alarm.

The shunt type master box shall be installed inside or outside of the building in a place designated by the official in charge of the municipal system and in a manner satisfactory to him. No. 14 B & S gauge copper wire shall be used for the auxiliary loop. This loop shall be installed in ½-in. rigid conduit with no breaks between the conduit and the boxes or the contactor which would allow the auxiliary loop to be exposed.



ENGINEERING SERVICE

Our Engineering Department is ready at all times to make surveys and lay out systems. This service is based upon more than sixty years' experience in the fire alarm field. Write or wire our home office or any of our branches and information will be furnished promptly.

BULLETINS

Complete information in bulletin form is available on the Dualarm System and all other forms of protection for the university group.

HENRY HOPE & SONS

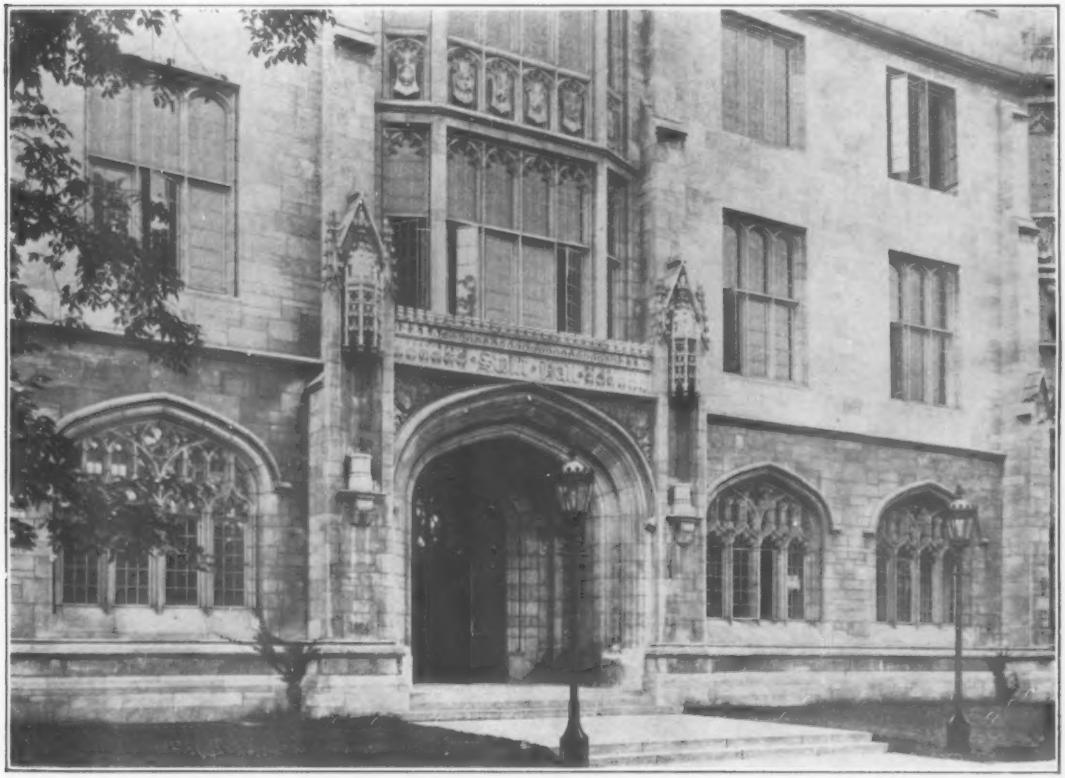
101 Park Avenue, NEW YORK

Casements in steel and bronze. Leaded Glass. Fine Hardware. Decorative Lead-Work.

For modern university and school buildings, as well as finer residences, leading architects of two continents specify Hope steel casements.

Hope Casements are installed in the following University Buildings:

University of Michigan, Ann Arbor, Mich.
Avon College, Avon, Conn.
Baltimore City College, Baltimore, Md.
Women's College, Birmingham, Ala.
University of Chicago, Chicago, Ill.
Cornell University, Ithaca, N. Y.
Yale University, New Haven, Conn.
Vanderbilt University, Nashville, Tenn.
University of Pennsylvania, Philadelphia, Pa.
Princeton University, Princeton, N. J.
University of Richmond, Richmond, Va.
Vassar College, Poughkeepsie, N. Y.
Wellesley College, Wellesley, Mass.
McGill University, Montreal, Canada.
Toronto University, Toronto, Canada.



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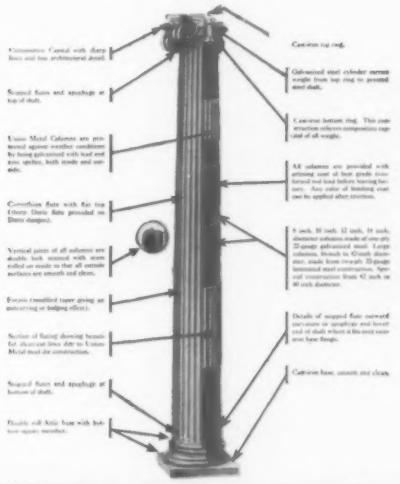

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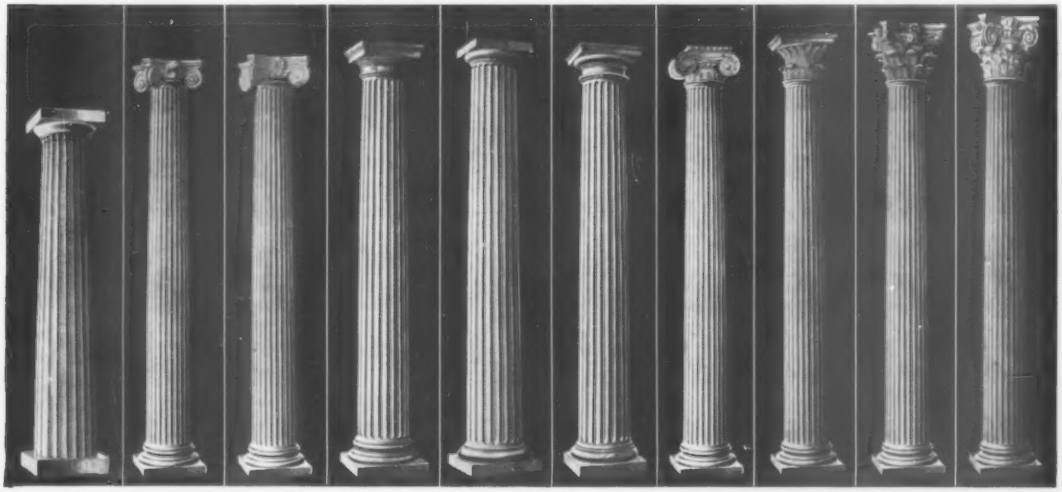

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Section II

UTILIZATION AND MAINTENANCE OF BUILDINGS AND GROUNDS

School-Building Utilization

BY EDGAR L. MORPHET

PROFESSOR OF EDUCATION, ALABAMA POLYTECHNIC INSTITUTE, AUBURN, ALA.

WHAT proportion of the instructional space in school buildings is being used during regular school hours for educational purposes? What proportion may desirably be used? A discussion of utilization is concerned with questions such as the above, rather than with questions relating to the use of buildings after school hours or at night for extra-curricular or community activities.

A few years ago (1926) the author made a detailed study of the utilization in 52 buildings housing either senior or junior-senior high schools.[1] One phase of the study dealt with the proportion of the available instructional rooms being used for educational purposes; another phase with the seating or pupil-station utilization. Since these buildings were selected at random, the construction dates ranging from 1856 to the year the study was made, and the enrollment from 74 to 3,987 pupils, it is considered that the percentages obtained are fairly representative of the utilization situation in the average secondary school.

Room Utilization in 52 High Schools

The average percentage of room utilization for the entire building during all periods in the schedule was found to be only 68.7. Based on class periods only, the average was found to be 75.4 per cent. This may be interpreted to mean that in the average secondary school it may be expected that only about three-fourths of the instructional rooms will be used for instructional purposes during regular class periods, and slightly less than that on the basis of all periods in the schedule. The rooms in the buildings studied were classified and percentages obtained for each type of room. Study halls and libraries were highest, with average percentages of 83.4 and 82.9 respectively, based on all periods in the schedule, and cafeterias and auditoriums were lowest, having average percentages of 25.5 and 37.0 respectively.

[1] See Morphet, Edgar L.: "The Measurement and Interpretation of School Building Utilization." Bureau of Publications, Teachers College, Columbia University, New York. 1927.

Of course, in many of the more congested buildings the percentages of room utilization ran much higher than the averages given above. A special study was made of the ten buildings which were obviously the most crowded and in which the percentages of room utilization were the highest found. For the entire building the average for the ten schools on the basis of all periods in the schedule was found to be 76.2 per cent, and the 75 percentile, 78.4 per cent. On the same basis the averages for certain types of rooms were found to be as follows: academic classrooms, 82.1 per cent; study halls, 89.0 per cent; libraries, 83.3 per cent; chemistry laboratories, 66.1 per cent; wood shops, 51.6 per cent; auditoriums, 42.2 per cent; and cafeterias, 40.1 per cent. This seems to indicate that even in the most congested schools only slightly more than three-fourths of the instructional rooms available may be expected to be used.

Utilization of Seating in the 52 Schools

As would be expected, the percentages of pupil-station utilization were found to be somewhat less than those for room utilization. The average for all the buildings studied was only 38.2 per cent on the basis of all periods in the schedule, and the average on the same basis for the ten most congested schools was only 44.7 per cent. This indicates that even in the most crowded buildings slightly less than one-half of the available pupil stations may be expected to be used during the regular school day, and suggests that buildings should be planned and capacity computed accordingly. This low percentage is due partly, of course, to the large number of unused seats in the auditorium during most of the periods. Percentages for the various types of rooms are somewhat more significant. It will be found that the 75 percentile for each type of room will *very seldom be exceeded* even in the most congested schools, therefore this may be taken as an indication of the probable maximum utilization expectation. Percentages for a few types of rooms are listed on the next page.

PERCENTAGES OF PUPIL-STATION UTILIZATION

Type of Room	Average for All Schools	Average for 10 Congested Schools	75 Percentile for 10 Congested Schools
Academic classrooms ...	56.6%	62.9%	69.1%
Study halls	59.8	72.5	80.7
Libraries	61.8	68.8	79.4
Typing rooms	48.5	56.5	59.8
Science lecture	37.0	51.2	59.4
Chemistry laboratories..	32.8	45.4	57.2
Mechanical drawing	46.4	57.9	65.9
Foods laboratories	35.0	43.9	54.5
General shops	55.1	62.7	69.9
Auditoriums	9.2	10.9	12.0
Cafeterias	21.7	31.3	38.3

Based on class periods only, the percentages of pupil-station utilization average about 5 per cent higher than those given above for each type of room.

It thus becomes clear that 100 per cent either of room or of pupil-station utilization may not be expected to be attained in practice in the American secondary school building. From the point of view of mere economy in dollars and cents, the attainment of this percentage might be held up as the ideal. From an educational point of view, however, it is very doubtful if anything near 100 per cent of utilization of the typical building would be desirable, even though practicable. Were the building ideally adapted to the educational program, the case might be different, but few, if any, buildings are so adapted.

Periodic Utilization Analyses Should Be Made

There may be only one major reason or factor, but there are also probably several minor factors that enter to determine whether the percentage of utilization is low or high in any given building. These may be as obvious as a small number of pupils to be housed in a large building, may be subtly concealed in building deficiencies, or may be buried in traditional educational policies. As long as these factors remain undiscovered or unknown, the percentage of utilization in a building will remain low, or a higher percentage may be secured through unnecessary crowding or by means of certain undesirable educational practices. A careful and detailed utilization analysis should therefore be made at periodic intervals in every building in order that these factors may be brought to light and the necessary adjustments made in the interest of economy and progress.

In the following paragraphs some of the factors that are most likely to affect the percentage of practicable utilization in any building will be pointed out and briefly discussed.

The Building Should Be Adapted to the Educational Program

It should be obvious that the less a building is adapted to the educational program offered, the lower the percentage of practicable utilization is likely to be. In any building, one room, one type of room, or several types of rooms may be found that are not adapted to the educational program, either because the educational program has been modified from time to time but no corresponding change has been made in rooms or equipment, or because the building may have been planned with more rooms of a particular type than have been needed at any time; in other words, the building may not have been planned to fit the educational program to be offered.

In buildings that are not well adjusted to the educational program, an analysis of the utilization will probably show certain types of rooms with a very high percentage of use, while other types will be found to have very low percentages. One of the buildings included in the study mentioned above affords a very striking example of this point. In this building there are 20 rooms planned and equipped to be used for science, and only 24 academic classrooms. At the time the study was made, the percentage of utilization of the academic classrooms was found to be 75.8, and the auditorium, poorly lighted and equipped only with traditional seats with no tablet arms, was in use every period of the day for study. Percentages of room utilization for the science rooms ranged from 23.3 per cent in the chemistry laboratories to 64.7 per cent in the biology laboratories. Further analysis showed that 65.2 per cent of the use of the science lecture rooms and 46.4 per cent of that of the biology laboratories was for purposes other than science. When more buildings are planned to fit the educational program to be offered, when more are planned so that adjustments can be made from time to time, and when changes or adjustments are actually made in buildings to adapt them to changes that have been made in the educational program, the percentage of practicable utilization for each type of room will be greatly increased and the number of congested buildings with such uneconomical and undesirable conditions as are pictured above will be greatly decreased.

Occasionally, even yet, school buildings are constructed with a number of basement rooms planned to be used for instructional purposes. Whenever these rooms or other rooms in the building are, as all too often happens, poorly located, improperly lighted, inadequately heated or ventilated, or are dingy, damp, odorous, or otherwise unattractive, the percentage of practicable utilization is lower than it should be. In hundreds of buildings over the country, rooms that were designated on the plans as classrooms, have within a very few years degenerated into so much waste space simply because of physical undesirability of one kind or another. The practicable utilization of a room is determined by its educational fitness rather than by the lettering put on the blueprint by an enthusiastic architect.

Rooms that are outstandingly large or small lend themselves to but limited usage. The auditorium, for instance, is considered undesirable for most classes not only because of the specialized seating equipment, but also because of its size.

Highly specialized equipment tends to limit the usage of a room to classes of a single type. In a

large school having several classes of each type, rooms with specialized equipment may be used practically as much as other types of rooms, but in small schools with few classes requiring the specialized equipment, the percentage of utilization of such rooms is likely to be very low. In many schools an effort has been made to simplify this problem by installing equipment that can readily be used both for laboratory and for lecture or class work.

Educational policies often prove almost as significant as the building itself in determining the percentages of utilization. For example, if each room is used only for the specialized purpose for which it is equipped, the percentage of utilization will be much lower than might otherwise be possible. Particularly will this be true if the policy is carried to the extent that one room is used only for Latin, another only for English, and so on. Ideally, it might be desirable to have a different room or group of rooms set aside for each type of work carried on in a building, but in many if not most cases the demands for space and economy make it impractical to carry out this policy rigidly and fully. It would seem, however, that if any type of room is to be used for more than one purpose, as is so often the case in practice, both room and equipment should be designed with that point in mind.

A Skillful Schedule Maker Is Essential

In addition to reflecting building and equipment inadequacies, the percentage of utilization of any building undoubtedly mirrors the efficiency or inefficiency of the schedule maker. To plan a schedule that will make possible the greatest percentages of utilization for a given building with a given educational program requires unusual skill and unfaltering patience. As several investigations have shown[2], much loss frequently comes from failure to distribute the classes evenly throughout the day. Other losses often occur in the use of rooms in which certain types of classes meet but two or three times a week. Rooms in which classes are scheduled to meet less than five times a week are likely to be vacant one or more periods despite the best efforts of the schedule maker.

The percentage of utilization is also influenced by the types of periods found in the schedule. For most types of rooms the percentage of utilization is somewhat higher on the basis of class periods only than on the basis of all periods in the schedule. If only certain types of rooms are used for home-rooms, if all rooms except the auditorium are vacant during the auditorium or assembly period, and if all rooms except the cafeteria are idle during the noon period, the percentage of utilization on the basis of all periods in the schedule, particularly in a large school, will probably be considerably lower, and the number of pupils that can be accommodated will be less, than if some of the classrooms are in use during the lunch and auditorium periods.

[2] See Packer, P. C.: "Housing of High School Programs." Bureau of Publications, Teachers College, Columbia University. 1924.

Effect of Number of Class Periods

What is the effect on utilization of increasing or decreasing the number of class periods in the day? The number of pupils and the average number of classes per pupil remaining constant, increasing the number of class periods increases the number of study sittings required, and, conversely, decreasing the number of periods decreases the number of study sittings required. Increasing the number of periods, however, increases the number of possible class meetings because it increases the number of periods any room is available for classes. Increasing the length of the school day, then, by increasing the number of periods will increase the capacity of the building materially only in case there are ample study seats available outside of the regular classrooms. One of the first steps regularly taken to increase capacity or to relieve congestion seems to be to increase the number of class periods in the school day and then, in many buildings, to shunt the overflow of students into the auditorium for supposed study. The wisdom of thus providing opportunity for pupils to build up wrong and even harmful study habits, in order that the capacity of a building might be increased by a method that is probably far less effective than some others that might be used, should be open to serious question.

"Staggering" a schedule has practically the same effect on capacity as increasing the number of periods in the day, as explained above. The class capacity is increased because each classroom is available a greater number of periods during the day than would otherwise be possible, but the pupil capacity is materially increased only in case there is an "overflow reservoir" in the form of an auditorium or some other large room into which the pupils not accommodated in the classrooms can be put for study or other activity. A school may profit from a staggered schedule when (1) there are too few rooms of a particular type to accommodate the classes of that type during the regular school day, provided the other types of rooms including the study halls are ample, or (2) when there are a great many students to be cared for during an emergency and the educational program must frankly be sacrificed to immediate need. While the actual capacity may be increased, the percentage of utilization, because of the greater time involved, may really be somewhat decreased. When half-day sessions are introduced, the capacity for the entire day may be practically doubled, but the actual percentages of utilization for each session will appear less because the congestion is relieved.

The factors that have been discussed above influence the percentages both of room and of pupil-station utilization. There are, however, certain factors that have a more direct effect on pupil-station utilization than on room utilization.

Relation of Class Size to Room Size

While a classroom that is unusually large may be used every period of the day, only a small proportion of the seats in the room is likely to be in use. Investigations show that the percentage of utilization of such rooms is likely to be quite low. If most of the rooms are much larger than the average class size, the percentage of utilization for the building will necessarily be low unless some such device as the rear-seat-study plan is used.

Classes vary in size in any secondary school or college no matter how large or how small the enrollment. If all the academic classrooms in a building have the same capacity, the size of each room being of necessity approximately that of the largest class, the percentage of pupil-station utilization even with the most efficient schedule would be considerable less than 100. If the classrooms vary in size in any building, the degree to which 100 per cent of pupil-station utilization is approached will depend upon the skill with which the classes are adjusted to the classrooms to which they are assigned. In very few schools will the percentage of adjustment of classes to academic classrooms be found to be greater than 85.2 per cent, the average of the ten highest cases found in the study previously mentioned. This percentage is suggested as a tentative norm by which the efficiency of the adjustment of academic classes to classrooms in any building may be determined; 85.8 per cent is suggested as the tentative norm by which the efficiency of adjustment in all rooms except the gymnasium, auditorium and lunch room may be measured. This may also serve indirectly as a measure either of administrative or of building efficiency or inefficiency. If the rooms in a given building are so large that the classes could not reasonably be expected to be adjusted to them, the inefficiency to be corrected is in the building; it probably even dates back to the planning of the building. If, on the other hand, the rooms are reasonably small, the school large, and still the adjustment is poor, then the inefficiency may be in the administration.

The policy concerning the assignment of rooms to teachers is also likely to have a marked effect on utilization. If each teacher meets all of her classes in the same room and the room is used for no other purpose, it will probably be vacant one or more periods during the day. Moreover, the largest class may be entirely too large for the room, while the smallest may leave a large proportion of the seats vacant. In most schools that are approaching congestion some sort of compromise plan is usually found to be necessary to increase the utilization.

There are, of course, other factors that may affect the utilization of any building. These will be brought to light by a careful utilization analysis such as has been suggested.

Forms for Utilization Analysis Are Available to Administrators

One important function of a detailed utilization analysis, then, is to aid in discovering the factors in any situation that influence the percentage of utilization and, thus to make it possible to take steps toward making needed adjustments. Another important function is to provide the administrator with objective data concerning the amount of congestion in his buildings. Facts and figures are more convincing than subjective opinion. Just as a score card may show objectively the physical condition of a building, so a properly made utilization analysis will show objectively the relative congestion in a building and in the various types of rooms in a building. The procedures for collecting essential data, computing the utilization percentages, and making comparisons, have been standardized and simplified so that reliable computations and comparisons may readily be made.[3] In other words, the application of these techniques will provide the school administrator or surveyor with one more means of measuring objectively certain aspects of the adequacy of the school plant.

[3] See The Strayer-Engelhardt-Morphet School Building Utilization Forms. Bureau of Publications, Teachers College, Columbia University. 1927.

A Scientific Approach to Maintenance

BY H. M. SCHWARTZ

DEPARTMENT OF EDUCATION, THE ST. LAWRENCE UNIVERSITY, CANTON, N. Y.

A COMPARATIVELY recent study of the problem of maintenance of public school buildings[1] disclosed to the writer the fact that up to 1925 there had been slight, if any, attempt made to determine either the frequency or the cost of various types or kinds of individual items of repairs to public school buildings. Search for available literature in the field included the reading of magazine articles, surveys of public schools in the United States, annual reports of school boards, published dissertations, and special studies in school finance. A systematic investigation disclosed no reference to the study of individual items of repairs to school buildings, nor the recording of them in available records or reports.

A preliminary inquiry was sent to 433 cities, selected because of the completeness of their system of financial accounting. From this list of selected cities 227 replies were received. Of these replies, 30 were from cities claiming to have complete data for a period of from three to five years. Of the 110 cities in the population group 10,000 to 30,000, from which responses were received, 40 reported that the record of the cost of repairs is kept by buildings. Forty-three of the 83 cities in the population group 30,000 to 100,000 answering the inquiry reported keeping the cost of repairs by buildings. In the group of cities having over 100,000 population, 26 of the 34 reporting indicated that they kept records of repairs by buildings. Of 518 published annual reports of city and village school systems studied, 34 indicate that they have kept their records of repairs by buildings. The population range of these cities is from 13,800 to 1,800,000.

Permission was obtained from the superintendents of schools in most of the cities from which affirmative replies were received to use the records for the purpose of making this study. Inspection of records and reports available in the first six cities visited disclosed that not one of these cities had records so complete as had been indicated in the replies to the preliminary inquiry. The sixth city did have records of individual repairs for the year ending December 31, 1924, only. These were in the form of "job orders" issued for repairs made by the repair force directed by the superintendent of buildings for the school board, "open orders" for repairs made by local tradesmen or contractors for amounts under $100, "contracts" awarded to tradesmen and contractors for amounts in excess of $100, "open order register" in which were listed in numerical order all "open orders" for the year ending December 31, 1924, "awards register" in which were listed "contracts" for the year ending December 31, 1924.

While there were found no indications that maintenance expenditures accounting was carried on in such a manner that the costs of labor and materials could be isolated in the case of each item of repair, there was, however, brought to light in summarizing the replies from the preliminary inquiry considerable evidence that there has been developing—possibly prior to and certainly since the study made in 1921 under the direction of "The National Committee for Chamber of Commerce Cooperation with the Public Schools and the American City Bureau"—desirable refinements in cost accounting covering particular services such as heating, plumbing, lighting, etc.

One is perhaps justified in suggesting at this point that there is a serious question as to the use to which such minutiæ of facts could be put.

Why Such Detail?

There is precedent, no doubt, for the refinements in accounting in connection with the most significant items of repairs found in the practices of large corporations, like the American Telegraph and Telephone Company in numbering certain items of equipment such as poles and instruments, or the New York Central Lines in dating railroad ties. There may be warrant for recording such details with respect to the frequency and cost of individual repair items on the basis of determining the expectancy of the life of individual elements in the structures used for school purposes. One might also consider the significance of such information to architects, contractors and builders, and boards of education interested in drawing up plans and specifications for new buildings or the remodeling of old ones. There is no doubt that the numbering of certain items of furniture by certain large corporations serves both as a means of identification for inventory purposes and as a basis for determining the maintenance costs for the particular item.

Such a scientific determination of fact may win support on the basis that the accumulation of the data will disclose some desirable limitations with respect to the character of materials and methods of fabrication most desirable for uses in public school buildings. But aside from the speculation involved, there remains the fact that already, more and more, the progressive cities are demanding that the expenditures for various types of services be isolated. This procedure is but a step behind the establishment of such a system of ac-

[1] Schwartz, Harwood Muzzy: "Improvement in the Maintenance of Public School Buildings." Bureau of Publications, Teachers College, Columbia University, New York. 1926.

counting as seems adequate and desirable with respect to the most important items of repairs. The items may vary from city to city because of climate, the nature and quality of materials used in the structures, the policies of the cities with respect to the protection of buildings and equipment, the quality of the services received and paid for under the head of "operation," etc. However, there seems to be substantial justification for selecting as a point of departure at least ten of the most important items of repairs in order that the data may be available to those most vitally interested.

COMPARISON OF THE UPPER THIRD OF THE FREQUENCY AND COST DISTRIBUTIONS

Combined Subhead	Ranking According to Greatest Number of Cases	Ranking According to Greatest Relative Cost per Job
Painting	4	1
Boilers	3	2
Grounds	5	3
Glazing	2	4
Roofs	10	5
Stairways—fire-escapes	16	6
Bells	1	7
Sash cords	6	8
Doors	11	9
Wiring	7	10
Drains	12	11
Fixtures	9	12
Floors	31	13

The table reads as follows: The combined subhead, painting, ranks fourth in the distribution according to the greatest frequency of cases reported; first according to the greatest relative cost per job.

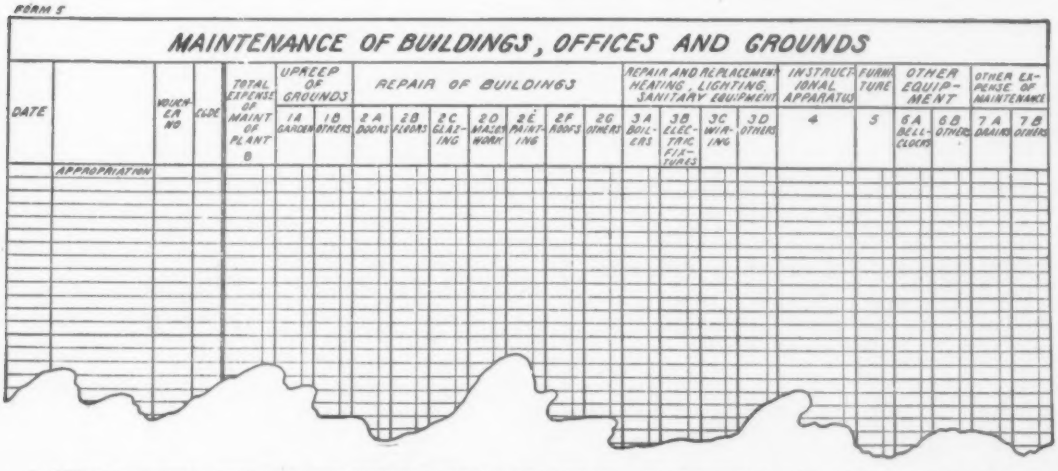
How Important Are These Items?

The extent to which research with respect to any of these items is to be carried on will be influenced, (1) by the degree of interest in determining the factors that have contributed to a significant degree in placing a particular subhead in its position of importance, such as the quality of the materials used, the skill of those engaged in fabrication of these materials, the plans and specifications according to which elements were constructed or repaired, together with the use and the abuse to which the element is subjected; (2) by the cost of recording the required data with the degree of refinement necessary; (3) by the practical applications that may be made of the facts once they are available; (4) by the economies that may be derived from the improvement in the quality of materials used, added skill in fabrication of these materials and improvements in planning structures and their equipment; (5) by the degree to which greater care is exercised in the operation and protection of particular elements; (6) by the degree of refinement to which the data may be subjected.

Productive industry has adopted certain refinements in maintenance accounting in part for the purpose of determining next steps in ferreting out the elements in construction as well as the mechanical equipment demanding improvement that will reduce the cost of repairs. Whatever the elements of the structure that may be included in the list of "most important items of repairs" in a given city, there will be needed a thoroughly efficient organization of the practices with respect to maintenance and maintenance accounting. At the outset there must be built up in the minds of those responsible for maintenance a point of view which includes not alone the insurance against interruption of a service to children, but also the most efficient service possible with the materials employed; not only the actual operation of the physical plant, but the continuous operation without attracting attention to the plant; and, in addition, the recording of data pertinent to a scientific study of the problems of maintenance.

Making the Program of Repairs

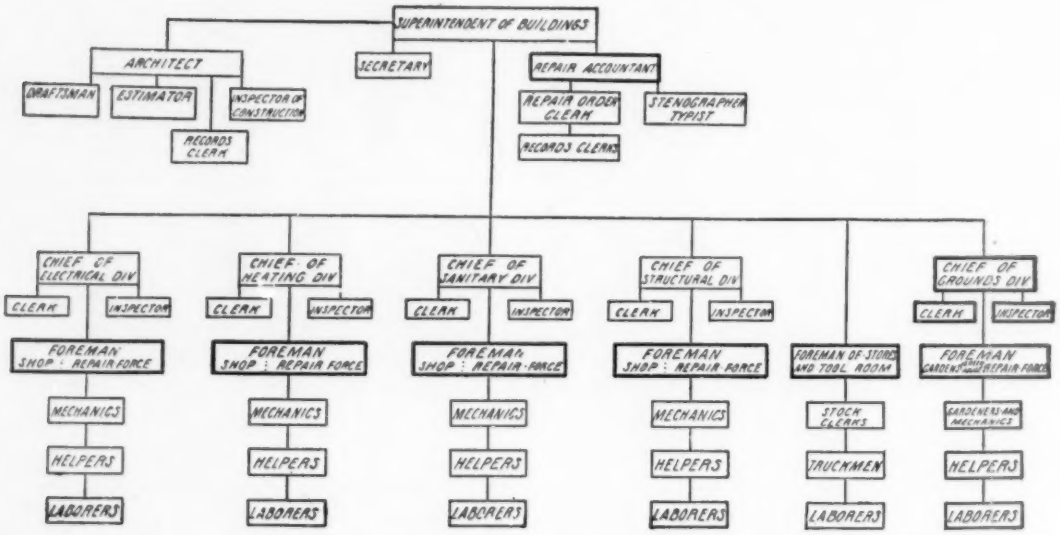
Subsequent to this development, one should determine the most important items of repairs for the particular city in which he is located, in order to organize the maintenance sheet of the distribution ledger to meet the demands of his situation. The need for substantiating records and reports


FORM 5

MAINTENANCE OF BUILDINGS, OFFICES AND GROUNDS

DATE		VOUCHER NO	CODE	TOTAL EXPENSE OF MAINT OF PLANT B	UPKEEP OF GROUNDS		REPAIR OF BUILDINGS							REPAIR AND REPLACEMENT HEATING, LIGHTING, SANITARY EQUIPMENT			INSTRUCTIONAL APPARATUS	FURNITURE	OTHER EQUIPMENT		OTHER EXPENSE OF MAINTENANCE	
					1A GARDEN	1B OTHERS	2A DOORS	2B FLOORS	2C GLAZING	2D WATER WORK	2E PAINTING	2F ROOFS	2G OTHERS	3A BOILERS	3B ELECTRIC FIXTURES	3C WIRING	3D OTHERS	4	5	6A BELL-CLOCKS	6B OTHERS	7A DRAINS	7B OTHERS
	APPROPRIATION																					

A LEDGER SHEET SHOWING SUGGESTED FORM FOR REPAIR DISTRIBUTION FOR SCHOOL BUILDINGS



ORGANIZATION CHART FOR SCHOOL-BUILDING MAINTENANCE FORCE

is evident. Housing the repair activities in one building—or even one shop if the system be small—suited to the needs of the undertaking, will tend to make for efficiency in organization, execution and accounting. Logically, one's attention turns to the requisition for, or reporting of, needed repairs. The details of the procedure an administrator in this field will adopt are of minor significance to the writer, provided that there be established a policy whereby repairs are reported to the proper officer as soon as the need is discovered, so that the operation of the plant or a significant part thereof may not be interrupted. And, further, a continuing repair survey should be maintained.

Possibly the word "survey" has an unpleasant connotation in the minds of some. If the word is offensive, consider the listing of the preliminary requisitions for repairs sent in to the central office by the principal and engineer-janitor of each building, by building, so that the proper officials may have the record of what work is demanded under the heading of each of the three classes of repairs, "emergency," "imperative," and "desirable."[2]

The form in which the repair survey is set up may well be adapted to suit the preference of the administrative officer. Requisition blanks may be employed of uniform size adapted to a card index or loose-leaf filing plan, and thus make for economy in its operation. Such a device is particularly effective and flexible when the inspectors are checking the requisitions against the actual conditions, making cost estimates for each job and summaries for each building. Each job should be coded and classified as emergency, imperative, or desirable. As early as is practical, a conference with those responsible for the preparation of the general budget should be held and the repair budget approved. With the budget approved, the summary of repair jobs can then be authorized and the several jobs numbered. The authorized summary of repairs should then become the work program for the department of buildings for the ensuing year.

The work program of repairs should be executed without partiality. Repairs should receive attention of the department of buildings and grounds in that sequence which will make for the greatest economy of time, service, and material. Economy of time here has reference to both the time involved in actual repair work and the time resulting from any interruption of service to children. Other things being equal, the energy of the principal, the influence of a board member, the economic or social status of the section in which a building is located, should not influence the administration of the work program. Mention is made here of these factors influencing maintenance of buildings because of the fact that in the writer's study (for the book, "Improvement in the Maintenance of Public School Buildings") age, score, and type of building were not the most important elements associated with expenditures for repairs as then distributed among the 375 buildings in the city under consideration.

The Repair Budget

The jobs to be included in the work program for each building having been determined, the repair budget should be set up in detail. The

[2] Grading repair jobs:

Emergency: A job that prevents the operation of the plant or a significant part thereof until repairs are completed.

Imperative: A repair that must be made in the immediate future to prevent damage to other elements of the plant, a job that would materially increase the cost of repairs if postponed over a period of months.

Desirable: A job that may be postponed over a period of months without materially increasing the cost thereof or the deterioration of the element.

total of the maintenance appropriation in the general budget of the board of education should be distributed equitably over the several buildings. The distribution should be made in keeping with the needs of a particular building and the system as a whole. The repair ledger account for each building should show the amount of the maintenance appropriation apportioned to it. Against this appropriation should be charged the work orders as they are issued. These items should stand as an encumbrance against the appropriation for repairs. The difference between these charges and the appropriation for a particular building should show the unencumbered balance remaining in the account.

A System of Records and Reports

The execution of an adequate program of building maintenance involves more than the adoption of a maintenance policy, the organization of the repair survey, and the authorization of the repair budget and the work program. It involves the inauguration of a system of records and reports adequate to meet e needs of the department of buildings with i stores or warehouse, its repair force, and its clerical equipment. It involves building up in each division a proper attitude towards mechanical, clerical, administrative, and scientific efficiency in serving children, teachers, and the patrons of the system. It involves the organization of the repair force and the shops on a basis equal to that obtaining in the best of the several trades, together with a systematic routing of work through repair shops such as has been developed in productive industry.

Such an organization demands the installation of a system of records and reports that will provide an adequate check on the expenditures made and account for the distribution of materials and purchased goods. Provision should be made at the outset to keep records in such a manner that intelligent use may later be made of the data involved. Equally important is the advantage of having these records cleared through one central agency. The repair accountant in the office of the superintendent of buildings is the logical center of the system of records and reports for the department of buildings.

The detail with which records relating to repairs are kept will be dependent upon the clerical assistance provided. Repairs should continue to be kept by buildings. A further degree of accuracy is desirable. Repair costs should be so kept by buildings that each structure stands alone as a unit. The practice of including portables, annexes, etc., within the supervising principal unit is misleading and inaccurately attaches to a fairly good building, repair costs that should be borne by the building actually receiving the benefits of the expenditure. With respect to an individual job order, care should be exercised to include on a given order one type of repair so that accurate cost accounting for the most important items of repairs may be extended to determine, for example, what is the life of a given type and make of boiler.

Stockroom records should be kept with such a degree of detail that they contribute their share to the solution of the problem. They should include platform records or receiving door records of goods received, at stores and at any of the several school buildings direct from vendors. Daily reports should be made to the repair ledger clerk of goods received and goods issued. Bin cards, stores ledgers, goods distribution record, and a file for goods requisitioned by the foreman for authorized jobs should be employed. At least a semi-annual inventory of stores should provide a check on the stores account for each item of material or goods in the stores.

The purchase of materials may well be done through the agencies already established, if these offices are now functioning in keeping with the most efficient practices. Purchases should be made on requisition of the stockroom warehouse foreman, approved by the superintendent of the department of buildings. So far as practical, all supplies and materials ordered by the department of buildings should be delivered at the general storehouse. Open orders to dealers and tradesmen demanding delivery of materials at a particular building should indicate the building to which the materials are to be sent. A copy of the form should be sent to the building when goods are ordered. The janitors of buildings should receipt for such goods when delivered. Care should be exercised in ordering materials of all kinds for maintenance purposes, that will insure adequate safeguards for both the department of buildings and the taxpayers in the city.

Measuring the Adequacy of the Maintenance Service

The adequacy of any repair program will be tested by the manner in which it functions pragmatically. The most carefully organized scheme may fail to operate if there is not a well-grounded opinion in the minds of those responsible for the administration of the plan favoring the practices suggested and formulated. "How it works" should be determined in keeping with the best practices in each of the trades concerned. The criteria by which to measure the adequacy of the maintenance service are herewith presented:

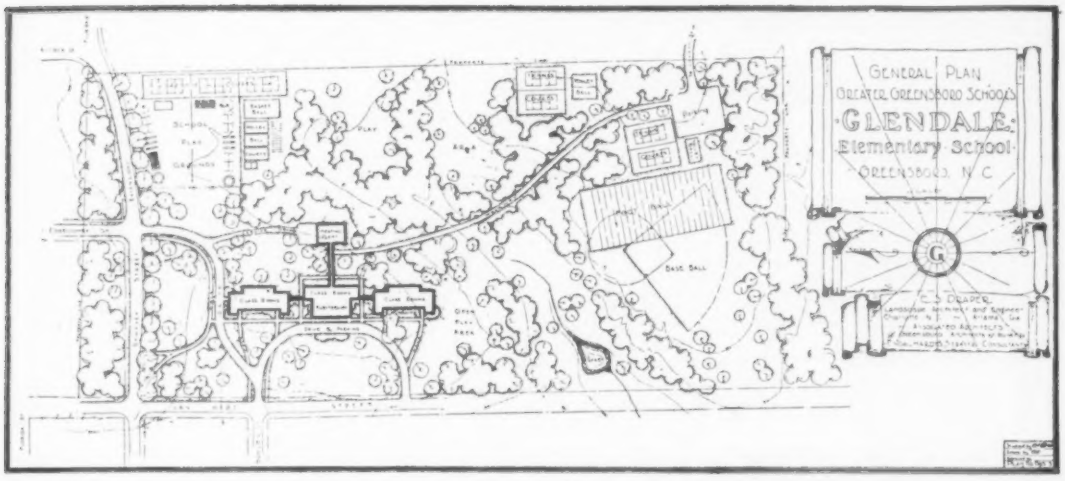
1. Does the plan operate in such a fashion that the building or buildings and equipment render continuous and efficient service?
2. Is there reasonable economy of time effected in reporting, authorizing and carrying out emergency, imperative, and desirable repairs?
3. Is there reasonable economy insured in connection with the operation of the department responsible for the maintenance of school buildings?
4. Does the organization of the department entrusted with the maintenance of buildings permit of a definite fixing of responsibility for the workmanship of mechanics engaged in the work?
5. Is there farsighted cooperation among departments in the system provided for in the policies of the organization?

6. Does the policy of the maintenance department provide for the periodicity with which repairs are requisitioned and a corresponding flexibility in the size of the repair force?
7. Has provision been made for the standardization of materials and techniques with respect to certain types of repairs as well as the preparation of plans and specifications?
8. Does the policy of the organization provide for routinization of repair requisitions and the economical recording of data covering individual items, materials, costs, and frequency of repairs?
9. Does the plan of recording data make readily available the facts necessary for the scientific study of the whole problem of maintenance?
10. Does the plan provide for a continuing survey of repair needs so that the department may anticipate labor needs and maintain an efficient organization of mechanics?
11. Is provision made to safeguard the quality of materials and services through the use of plans and specifications covering the "open orders" and "contracts" placed with tradesmen and contractors?
12. Is provision made to insure the distribution of expenditures on "open orders" and "contracts" among the individual items of repairs effected?

Why This Discussion Is Important

The purpose of the discussion has been to call attention to the desirable departures from the present practices in the maintenance of public school buildings. The suggestions presented will not be put into operation in their entirety at any given time. However, the desirability of making a beginning along a definite line of procedure is supported by the fact that present practices leave much to be desired if progress is to be made along scientific lines. The selection of the "most important items of repairs" seems to be an adequate point of departure upon which to base the necessary refinements in the field of maintenance accounting. The organization of the department of buildings may vary from the plan suggested according to the size, the equipment, and the policies of the school unit. The degree of efficiency with which the organization functions will depend in large measure upon the completeness with which the facts are assembled and upon the use to which they are put. The possibility of discovering inadequacies in the present program should encourage an immediate attack upon the problem. As cities adopt the various advance steps outlined, students in the field will have available data of a progressively valuable nature upon which to establish the relative worth, effectiveness of materials, and methods of construction employed in this field.

The value of such information lies in the fact that it makes available to those interested in school-building construction and repair, facts concerning the elements in a public school building that require the most frequent repair, the type of building that requires the least expenditure for repair, and the elements which, because of the frequency of need for repair, merit scientific study in order that faulty materials or fabrication may be improved. The information is desirable also in proportion as it points out the relative importance of the various types of repairs for the purpose of encouraging the suggested refinement of school accounting in this field as well as the need for a more scientific distribution of expenditures. A further value lies in the fact that a refinement in the field of maintenance accounting should make possible the scientific determination of the life of certain most important elements of the structure, and in non-instructional equipment of school buildings. The real significance of the suggested plan lies in the possible improvement of school-building maintenance, to the point of keeping the plant at a high degree of efficiency, each element functioning, contributing to the growth of happy children and to the satisfaction of an appreciative public.



New School Grounds Development at Greensboro, N. C.

BY E. S. DRAPER
FELLOW, A. S. L. A.; AND
H. B. BURSLEY, MEMBER, A. S. L. A., CHARLOTTE, N. C.

THE city of Greensboro, N. C., one of the most favorably located and flourishing cities of the Piedmont South, has undertaken an ambitious program of school expansion. Fortunate in having a far-sighted school board, headed by E. D. Broadhurst, Chairman, the city is in the process of working out a school program worthy of a city much larger than Greensboro.

There are six schools or groups of schools now being planned for construction—two elementary, one grammar, a Junior High, and a Senior High, a Junior High, and a Junior College on one tract, and a negro High School. The total land included in these six groups of schools is 379 acres. The two elementary and one grammar school occupy sites of 20 to 40 acres each; the Junior High, and the negro High each an 80-acre site. A tract of 129 acres has been reserved for a future educational group to serve one of the best residential sections of the city and to include the followings units: a Senior High School group of several buildings, possibly seven units; a Junior High School, a Junior College group, and an additional elementary school. This great work, now in process of accomplishment, has meant hard fighting on the part of those who see through to the completion of this task, in convincing the skeptics, but the job has been done, a large bond issue voted, and the work is well under way.

The first step taken by the school board was to call in Messrs. Strayer and Engelhardt to work out the actual location of sites and plan the expansion program. Then all of the registered local architects were asked to combine into an association, and the work of all the school planning was given to the Associated Architects of Greensboro. At that time the need for advice as to landscape arrangement of the grounds was appreciated with particular reference to selection of sites within the various areas for the buildings. and the committee selected E. S. Draper, landscape architect and engineer, of Charlotte, N. C., and Atlanta, Ga., to advise them and prepare plans for this part of the undertaking. At the start, considerable study was made by the landscape architect to determine the desirable natural boundaries of the tracts, and in several instances, after his report was given, it was possible to adjust boundaries with adjacent property owners so that the school sites were benefited and the adjacent properties improved.

A discussion of the features of the development of two of the four school groups now being undertaken is given below, and these features are illustrated in the accompanying reproductions of the two plans.

The Glendale School

The property chosen for this school consists of nearly forty acres, rather long in proportion to its width, and divided diagonally by a small valley. The larger part is nearly level and is half covered with an open, deciduous growth.

In order to make it easily accessible for that portion of the city which it is to serve at the present and for a long time to come, the building has to be located on the part of the property nearest the present driveway, somewhere in the northern half of the property. The location finally decided on was on the long ridge running north and south so that the building could have its main long axis north and south, and so located that one building of the group could be on the axis of Boyden Street. This north and south location makes the building practically parallel to Van Wert Street, which is the longest street bordering the property. The building group consists of three buildings connected by arcades for present use, with a fourth for future extension. The two main buildings of the present group are on the ridge, with the third building which is to contain the heating plant somewhat removed and on a lower elevation.

The areas immediately adjoining the building location to the south and west, out of the way of interference with approaches to the front and south of the buildings, are planned for general play during and after school hours. To the east of the building and shaded by a good-sized grove, are placed the areas for tennis courts, basket-ball courts, etc., and for playground apparatus. To get to this area from the school, children will not have to pass across any main driveway. These two areas will be used mainly by the younger children and by the children actually in school. The larger recreation field necessary for baseball, football, etc., will be more of a community playfield to be used by the neighborhood as a whole rather than by the school children. For such a use it should be farther away from the school building. It is located to the south of the building and separated from the building and areas next to it by a valley running diagonally across the property, and is of sufficient size to contain a football field and a baseball field, with tennis and volley-ball courts, as well as considerable area for parking.

Then came the problem of approaches. The property is bordered by only one street, Van Wert on the west, but will be approached from the north and east by two other streets equally important, Lovett Street on the east and Florida Street on the north. To provide for the proper connection of these streets Dempsey Street is extended across the property from Van Wert Street to the intersection of Aycock and Florida Streets. This extension not only serves the school, but will provide a needed east-and-west connection for the city plan. Van Wert Street is not yet developed, so that the main approach for the present will come from the Dempsey Street extension, taking off at the intersection with Edgecombe Street and reaching the north end of the building, passing from there to Van Wert Street at its intersection with Boyden Street. This approach drive, after the construction of Van Wert Street, becomes a secondary approach; the main approach will then be a horseshoe-shaped drive centering on the auditorium building, with an arm taking off from the intersection with Boyden Street. These driveways are all made 20 feet wide to allow for circulation of cars in either direction, and in front of the auditorium the drive is enlarged to provide for parking space. The service drive to the heating plant is a short direct drive from the secondary approach drive.

The walk approaches are as direct as possible, one from the intersection of Van Wert and Dempsey, and the other from the intersection of Van Wert and Boyden Streets. In so far as possible, they are kept from crossing the driveways, and where they do cross the driveways this is done as near the school building as possible so that the crossings can be controlled easily and result in the least danger to the school children walking. To connect from the building to the large recreation field there is a wide walkway crossing the valley. This also will serve as a foot traffic-way from the neighborhood north of the property to the recreation field. To avoid any danger to children playing on the grounds, it is thought best to keep all driveways from crossing the property, except at the very north end of the property and near the building. A drive approach necessary to get directly to the large recreation field can be made from a right-of-way near the south end of the property to Lovett Street.

The problem of adjusting grades to the building itself is very simple in this case. The ridge on which the building is located is very nearly level and slopes away from the building in all directions except the north, where it can be made to slope away by depressing the drive slightly below the grade of the building.

One problem in connection with the development of this property occurred through its being bordered on three sides by back yards or undeveloped property, only one side being bordered by a projected street. This problem has been solved on the north side by the extension of Dempsey Street, and by placing the building far enough away from the back yards so that the existing and added plantings will effectually screen the yards all along Florida Street. On the east side existing growth practically takes care of the back yards along Lovett Street, and to the south any future development will be so far removed from the building itself that no objectionable results can be foreseen.

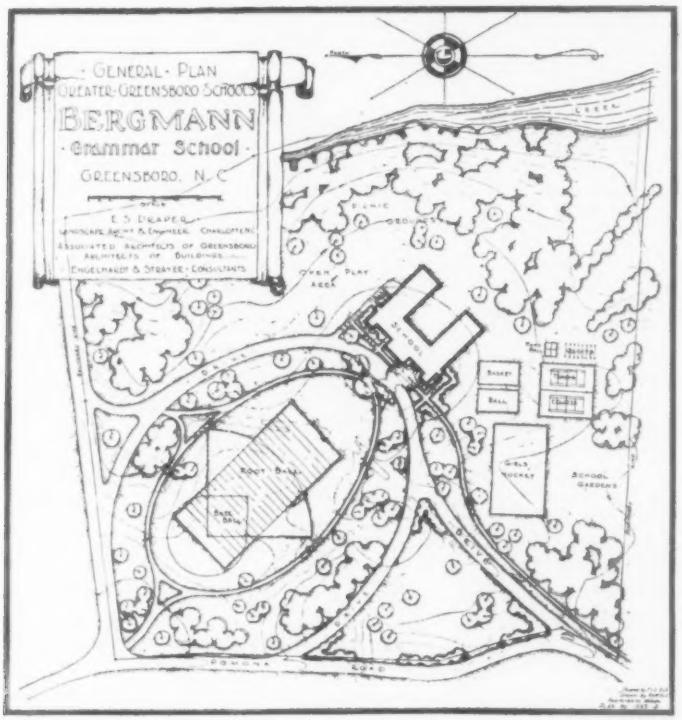
The Bergmann School

This property consists of about 30 acres, practically all open land, mostly on a broad, open ridge, with a slope to the east covered with woods. It is on the outskirts of the city, and although in the future it will serve residential sections all around it, at present it will mainly take care of the built-up section to the northwest which will approach the property along the Pomona Road bordering the property to the west. To serve the area to the east and north, the extension of a street is planned by the city to border this property along the north.

The most pronounced feature on the property, a group of beautiful, large white oaks, located on the highest part of the ridge almost in the center of the property, governs the building location, in order that the trees may give the setting. The building itself could have been set nearer the northwest corner of the property on just as favorable ground and have been somewhat nearer the approaches. In that case, the main recreation field would have been behind the building and would have taken in and destroyed these large oaks. By placing the building as shown, facing to the northwest, with the large oaks in front of it, and looking across the recreation field, a much better setting is obtained. Also, future extensions to the building will be to the southeast and will interfere with no part of the development of the grounds, as they would have, if the building had been located at the other side of the recreation field.

After determining the location of the building itself in relation to the main recreation area, the actual working out of this area gives no trouble, as a combination football and baseball field fits the property. The general play area is on both sides of the building and to the rear, and the play courts and small areas are to the south of the building on the hillside.

The approach driveway naturally takes the form of a large oval surrounding the main athletic field, branching to the southwest connecting with the Pomona Road, and to the northeast connecting with the proposed street along the north side. This driveway is made 27 feet wide, so that parking of cars can take place all along it on the side towards the athletic field and still give room for two lines of traffic. This will provide more than enough space for parking of cars during school hours, as this is an elementary school and few cars will be parked during sessions, but will be very necessary



during any special use of the athletic field, such as a football or baseball game. The main approach pathways from the northwest corner are kept entirely within the oval driveway and outside of the immediate play area of the athletic field until they are directly opposite the building, where they will necessarily have to cross the driveway. The pathway approach from the southwest nowhere crosses the driveway and is separated from it.

The development of the landscaping plans for the 129-acre educational group is under way as this article is written. This and the planning of an 80-acre Junior High School as a separate unit in a different section of the city, and a negro High School development of the same size, are not yet far enough along to include in this article, but will, however, follow the same intelligent and far-seeing basis of planning which has characterized the work now under way. It is important to note that these plans are all developed looking far into the future, and the ultimate needs of the locality which the schools are to serve have been considered both in plans for school and school extension and the use of the ground. Such a program as this carried to its completion will place the city of Greensboro among the front rank of those cities in the United States that are doing their utmost to see that the young people of the present generation are given every advantage possible, and should help in the development of future citizens of the highest caliber.

The Administration of Personnel for School-Building Operation

BY HARRY STANLEY GANDERS

PROFESSOR OF EDUCATION, UNIVERSITY OF CINCINNATI

THE operation and care of school buildings and equipment must soon be placed upon a scientific basis. The public sustains too great a loss through the incompetent care of million-dollar buildings and equipment that costs thousands of dollars. In response to stimulation supplied by Dr. N. L. Engelhardt, a comprehensive book presenting, more or less scientifically, solutions to problems incident to the care and operation of modern school plants has been produced.[1]

The superintendent or his assistant in direct charge of school-building management, the principal—or the janitor himself—can no longer claim competency in building management unless fully acquainted with the scientific studies that have been made[2] pertaining to economical use of materials and most efficient methods of vacuum cleaning, sweeping, scrubbing and mopping, the preservation of floors, woodwork and furniture; dusting, the care of toilet rooms, the cleaning of glass, and blackboard and eraser cleaning. Students of heating and ventilation problems are aware of the fact that relatively poor systems intelligently operated give better results than the best systems improperly used. Facts and principles bearing on efficiency and economy in the heating and ventilation of school buildings are therefore of first import to school-building personnel. The infinite variety of the problems with which the housing personnel have to concern themselves are only suggested under the headings of Cleaning, Heating, Ventilation, Safety Engineering, Sanitation, First Aid, Record Keeping and Report Making, Care of School Grounds, Repairs, Plumbing, and Care of Electrical and Other Equipment.

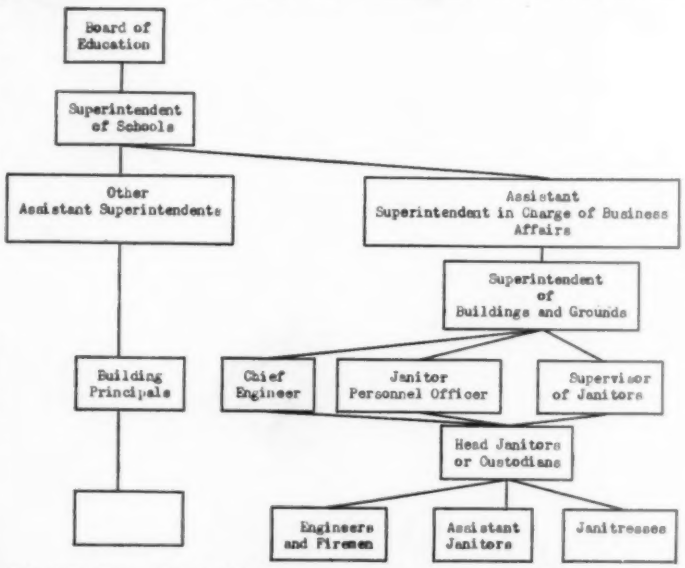
Importance of the Subject

School administration officers, having fairly well solved the major problems of assignment of load, salary schedule, selection, retirement and training as applied to teachers, are only now beginning to turn their attention to similar problems as applied to school janitors and engineers. That the importance of the whole field of school-building management is coming to the forefront of school administrative thinking, is evidenced by the statement by Superintendent J. C. Lefler of Lincoln, Nebr., who said, "If there is anything more important than the selection of teachers, it is the selection of janitors."

Recent issues of *The American Schoolboard Journal* have carried as many as two leading articles on janitorial service in a single number. Topics such as follow, find places on city, state and national educational conference programs: "The School Janitor," "The Janitor's Work," "Salary Schedules for Janitors," "The Selection of Janitor-Engineers," and "Training Janitor-Engineers." In 1926 a sectional program was organized for the Department of Superintendency on "Janitor-Engineering," which was eminently successful.

Organization of Personnel Responsibility

The personnel for school-building management in a *village* may consist only of janitors, firemen



ORGANIZATION OF SCHOOL-BUILDING MANAGEMENT PERSONNEL FOR A LARGE CITY

[1] See Reeves, C. E., and Ganders, H. S.: "School Building Management"; "The Operation and Care of School Plants." Bureau of Publications, Teachers College, Columbia University, New York. 1928.

[2] See Reeves, C. E., and Ganders, H. S.: "School Building Management"; Engelhardt, N. L., Reeves, C. E., and Womrath, G. F.: "Standards for Public School Janitorial Engineering Service"; and Reeves, C. E.: "An Analysis of Janitor Service in Elementary Schools"; all published by the Bureau of Publications, Teachers College, Columbia University, New York.

and a head janitor acting in the capacity of superintendent of buildings and grounds. Figure 1 shows the administrative personnel with its desirable relationships for a medium or large-size *city*.

This recommended plan places engineers, firemen, assistant janitors and janitresses under head janitors or custodians. Head janitors in turn have a quadruple responsibility to building principals, chief engineers, supervisor of janitors, and the janitor personnel officer. The latter three, preferably, should be made responsible to a superintendent of buildings and grounds. The superintendent of buildings and grounds should be under the superintendent of schools or his assistant superintendent in charge of business affairs. The superintendent of buildings and grounds and his staff should select, supervise, and promote janitors. On the other hand, it is the duty of the building principal to make sure that janitorial-engineering functions are performed. The fact that the principal is unable to tell janitors *how* to perform such tasks does not in the least invalidate his right to demand clean blackboards, dustless desks, transparent windowpanes, sanitary toilets, and economy in consumption of fuel.

The efficiency of a school-management personnel depends upon careful selection, thorough and specific training, acceptable conditions of employment and possibilities for promotion in salary and in position.

Selection and Training of Janitor-Engineers

A large majority of the school management personnel should be inducted into the service as *assistant* firemen or *assistant* janitors. Better results will be obtained if written applications followed by written and oral examinations are required. The applicant should present a physician's certificate showing that he suffers neither from disease nor from physical defect. He should have completed at least the eighth grade, present a clean and neat appearance, use acceptable language, be not under 18 nor over 45 years of age, and have in every respect an unimpeachable character. It is also desirable that the applicant have skill as a tradesman or mechanic, that he be married, educated beyond the eighth grade, and a non-member of labor unions and that he have received special training in janitor-engineering service. The examination should cover the following major divisions (a) School Health and Sanitation, (b) Methods of Work, (c) Principles of Operation of Mechanical Equipment, and (d) Complete Physical Examination. A probationary period of six months should precede permanent appointment. Amenability to training as well as present competence should be a factor given considerable weight. The janitor-engineer having once been carefully selected, and given permanent appointment followed by training, every reasonable effort should be exerted to give him steady employment.

Various methods are coming into vogue for the training of janitor-engineers.[3] Class and laboratory training has been in operation at Minneapolis since 1919. Four full-time instructors are employed. An individual attends classes two hours each week, twelve months in the year, for from three to six years. A summer school for janitor-engineers was inaugurated by the writer and President George Frasier, at Colorado State Teachers College, Greeley, Colo. The school is now in its fourth year. Janitor-engineers from the Rocky Mountain states become resident students at the College. There the work of sweeping, scrubbing, oiling floors, blackboard and eraser cleaning receive attention. There are lectures, demonstration, moving pictures, exhibits, and visitation bearing on firing furnaces, ventilation, plumbing, school health, personnel relationships, fire prevention, care of grounds and a number of other subjects.

Short extension courses for school-building management personnel have been developed at the State Agricultural College at Ames, Iowa, at the University of Wisconsin and other such institutions. Many city school systems provide a series of lectures to their personnel which extend throughout the year. Oakland, Calif., Cincinnati, Ohio, and Denver, Colo., have done notable work of this type. In addition to these methods, there have been developed, quite extensively, apprenticeship schemes which are in the main inferior to the plans described above but which nevertheless are beginnings that can be taken as evidence of a much-needed trend toward training school-building management personnel.

Qualifications for Promotion

Training is the first essential, but the effort will have been wasted if provisions are not made for promotion and retention. Promotion may take the following forms:

1. A change in position from a small, unorganized school system to a larger, well-organized system.
2. An advance in rank:

a. From apprentice or probationer to assistant janitor-engineer.
b. From assistant janitor-engineer to head janitor-engineer of a small building with no, or few, assistants.
c. From head janitor-engineer of a small building to head janitor-engineer of a larger building.
d. From head janitor-engineer of a large building to a member of the administrative or supervisory staff of the superintendent of buildings and grounds.
e. From a member of the staff of the superintendent of buildings and grounds to superintendent of buildings and grounds.

[3] Henzlik, F. E.: "Fundamental Elements in the Training of School Janitors," *American Schoolboard Journal*, pp. 51-2, July, 1927. Shaw, J. H.: "The Colorado Janitors' School," *American School Board Journal*, p. 66 f., August, 1926.

3. Classification with accompanying salary increases. Classification as A, B, C, D, etc., according to efficiency as determined by ratings, or examinations, or both.

Merit, rather than seniority, should be the basis both for promotions and salary increases.

In addition to the qualifications required for appointment, there should be other qualifications for promotion to more important positions in the janitorial-engineering service. These should deal largely with the degree of demonstrated efficiency of candidates and the new requirements of the advanced position. Some of these factors are the following:

1. *Experience.*—This should be counted toward promotion for as long a time as employees profit by it. Four or five years' experience are worth considerable in determining merit. Probably there is some value in experience up to eight to ten years.

2. *Training.*—Where there have been training courses, in the form of summer courses, laboratory courses in the system, lecture courses by experts, or other kind, employees should be given credit for having taken such courses. The reading of books and magazines dealing with janitorial-engineering should also receive recognition.

3. *Examination.*—High marks on examinations, such as were outlined in a previous section of this chapter, should be given considerable weight in making recommendations for promotion.

4. *Industry.*—Employees should be credited according to the quality and quantity of work performed. A man who does more work than is specifically required, who, for example, makes minor repairs, without waiting for some one to notice the need and require the work, should be given credit for industry.

5. *Personal qualities.*—Credit should be given for such personal qualities as those previously discussed.

6. Present age, present condition of health, marital condition, education beyond the eighth grade, and sex, should all receive consideration in making recommendations for promotions.

The matter of tenure is well covered in the following statement by Engelhardt, Reeves, and Womrath:

> "After janitor-engineers have been trained through apprenticeship or by other means, and have by trial proved to be satisfactory, they should be given indefinite or permanent tenure until it becomes necessary to discharge them for inefficiency, immorality, insubordination, or other sufficient cause." [4]

An average salary for janitors in 1,000 cities of various sizes in 1922 was $980.42. In 1927, the Research Division of the National Education Association[5] reported data showing the salaries of janitors for the school year, 1926-27, as follows:

1. Salaries of 1,692 school janitors in 557 cities of from 2,500 to 5,000 population ranged from less than $600 to over $2,600, the median being $1,202.
2. Salaries of 2,035 school janitors in 374 cities of from 5,000 to 10,000 population ranged from less than $600 to over $2,800, the median being $1,228.
3. Salaries of 3,225 school janitors in 298 cities of from 10,000 to 30,000 population ranged from less than $600 to over $2,600, the median being $1,309.
4. Salaries of 4,542 school janitors in 147 cities of from 30,000 to 100,000 population ranged from less than $600 to over $2,800, the median being $1,452.
5. Salaries of 6,529 school janitors in 59 cities of over 100,000 population ranged from less than $600 to over $3,800, the median being $1,390.

A survey of conditions of employment of school-building personnel in 1926-27 revealed a marked tendency to improve employment conditions for these groups. A number of cities pay for overtime, and allow two weeks' vacation with pay; unsanitary living quarters as pay is being discontinued; periods of employment are being lengthened; pay during absence on account of illness is being allowed; and in at least one state, Massachusetts, janitor-engineers are compensated for injuries received in the public service, and in another state, New Jersey, they participate as do teachers in the state retirement and pension system.

Service Loads and Service Costs

One of the major problems in the administration of school-building management personnel is the problem of determining service loads and service costs for particular buildings. The following are 22 factors of major importance which affect the problem:

1. *The Administration of the Building.*—In some buildings children are orderly and under their teachers' guidance, and thus reduce the janitor's load. In others, children destroy school property and carelessly add to the janitor's work. Principals may or may not protect janitors from abuse by teachers and pupils.

2. *Size of Building.*—It is evident that, for some cleaning jobs, a building of 40 rooms would constitute twice the load of a building of 20 equivalent rooms.

3. *Age and State of Repair of Building.*—An old building, in a poor state of repair, is, of course, more difficult to keep clean than a new building in good repair.

4. *Location of Building.*—School buildings in residential sections are much easier to keep clean than buildings in smoky, industrial sections. Buildings surrounded by trees and grass are easier to keep clean than buildings on windswept, sandy slopes.

5. *Climatic Conditions.*—Aside from the difference in the amount of firing required and the additional work entailed in caring for furnaces and boilers, the use of coal adds to the burden of keeping buildings clean. A building in the South where little firing is required would be easier to keep clean than one in the North; a building in California, where oil is often used for fuel, would be easier to keep clean than one in Minnesota, where coal is burned.

6. *Type of Building Structure.*—Whether the school building is constructed of brick or wood, two stories or four, well constructed or poorly constructed, greatly affects the janitorial service within the building. The following factors of construction will affect janitorial load: the building

[4] Engelhardt, N. L., Reeves, C. E., Womrath, G. F., "Standards for Public School Janitorial-Engineering Service," p. 12.

[5] National Education Association: "Salaries in City School Systems, 1926-27," Research Bulletin, March, 1927.

should be wired for the convenience of janitors and engineers; radiators should be sufficiently raised from the floor to allow of cleaning beneath them; motors should be accessibly located; there should be no unnecessary basement rooms; in high buildings there should be a chute for the disposal of classroom waste; there should be a chimney flue for the burning of waste; windows should be reversible to permit of ease in washing both surfaces; the furnace room should be properly located; and there should be sufficient installations of service systems.

7. *Kind of School.*—The median age of the pupils of a school corresponds, in general, with the kind of school. Whether the pupils are 6 to 12 years of age in an elementary school, 13 to 15 years of age in a junior high school, or 16 to 18 years of age in a senior high school, makes considerable difference in the work of caring for a school building.

8. *Social Background of Pupils.*—Anyone who has visited schools will recognize that the social background of pupils within a school determines to a marked degree the cooperation obtainable from pupils in keeping the building presentable.

9. *Enrollment.*—Certain janitorial functions must be performed regardless of whether 800 pupils or 1,600 pupils are in attendance. On the other hand, it is a well-known fact that the work of keeping a building clean increases with the greater amount of use.

10. *Type of Rooms.*—Room for room, other things being equal, a school giving only old-type elementary work is much more easily cared for than an elementary or high school having many special rooms for industrial arts, drawing, domestic science, etc.

11. *Amount and Kind of Floor Area.*—The kind of floor surface to be cleaned is important. A janitor can sweep, in a given time, twice as much area of good maple or terrazzo floor, as of splintered pine. Kind as well as amount must enter into the assignment of janitorial load.

12. *Area, Size and Location of Windows.*—Anyone who has tried to clean window glass knows that the location of windows and the size of panes affect the rate of cleaning as well as does the number of square feet of area to be cleaned.

13. *Area, Kind and Utilization of Blackboards.*—Slate blackboards, presenting a smooth, even surface, may be more easily and effectively cleaned than other types. The amount of use of blackboards varies greatly from room to room and from building to building.

14. *Type and Arrangement of Desks and Other Furniture.*—Certain kinds of school desks admit of cleaning a room much more quickly than do other kinds. The placement of furniture and sometimes the way the floor itself is laid, may force the janitors to sweep classrooms crosswise rather than lengthwise of the boards. This makes cleaning difficult.

15. *Size of Site, Playground Covering and Gardening.*—Playground covering has an important bearing upon janitorial load. A concrete playground, or one covered with clean, smooth pebbles or crushed stone, reduces the amount of dirt to be removed from the building; a clay or dirt-covered playground augments it. The size of yards and lawns and the amount of gardening and care expected of janitors in maintaining the grounds will affect the amount of service required for a particular building.

16. *Area and Placement of Sidewalks.*—Long sidewalks covering the natural route to building entrances, or the absence of them, are factors to consider in assigning a janitorial staff to man a particular building.

17. *Type and Condition of Heating Equipment.*—It makes a great deal of difference, in the amount of service required, whether buildings are heated by means of a hot-water or steam-heating plant, a hot-air furnace, or jacketed stoves. The condition and effectiveness of the heating apparatus must also be taken into account.

18. *Type and Condition of Ventilation Equipment.*—A building equipped with the unit ventilating system or a building ventilated by a system of "modified window" ventilation may require less attention by the janitor-engineer than one equipped with a fan system.

19. *Amount and Installation of Plumbing.*—Some kinds of plumbing are notorious for being constantly out of order and in need of repair, while other kinds prove quite satisfactory.

20. *Presence, Type and Condition of Service Systems.*—A building equipped with an ash hoist, coal conveyance, chutes, power, service elevators, and the like, will, of course, require less man-power in properly caring for it.

21. *Janitors' Shop and Store Rooms.*—Properly located and equipped shop and store rooms save time and add to efficiency of janitorial-engineering service.

22. *Cleaning Equipment.*—Such equipment as a central vacuum cleaning system and an electric scrubbing machine will lower the man-power requisites in caring for buildings.

The above are some of the more important factors that must be considered in assigning janitorial loads if assignments are to be just and equitable. Many of these, however, have been ignored in practically all bases yet developed for assigning service loads and determining service costs.

Fairly definite principles have been worked out for the construction of teachers' salary schedules. Few such principles have been worked out for the construction of salary schedules for janitor-engineers. The obstacle that stands in the way of constructing a salary schedule for janitor-engineers is the fact that fully 90 per cent of such employees are wholly untrained as regards formal training for their work, and are therefore in many respects, grossly inefficient in the performance of their duties. A salary schedule based upon averages of amounts now paid to America's largely untrained janitorial-engineering staffs, would not, and should not, be indicative of what will be paid in the future to well-trained, efficient janitor-engineers.

Salary Schedules

Following are four elements that probably should enter into salary schedule making for janitor-engineers:

1. **Experience.**—In most salary schedules for teachers a limited amount of experience is usually credited toward increases in salary. Increases for experience should stop when added experience does not bring added improvement. It has been estimated that teachers' work improves for from seven to ten years. Studies should be made to determine the amount of experience that will bring actual improvement in the work of janitorial-engineers. Credit for experience, so long as it makes for increased efficiency, should doubtless be allowed in salary schedules for janitor-engineers.

2. **Training.**—Teachers' salary schedules usually grant increases in salary for years of training. Salary schedules for janitor-engineers should doubtless grant increases for special training for their work. No one knows what training should be required for increases in salaries or how large the increases should be. Since there are few opportunities for janitor-engineers to secure training in their work, this factor would be little more than a matter of form at present.

3. Merit.—There is a growing tendency to grant increases in salaries for merit in formulating teachers' salary schedules. Merit is determined by a system of ratings of the work of teachers. Merit in the work of school janitor-engineers can be determined with greater accuracy than can merit in the work of teachers. This doubtless should be an important factor in constructing salary schedules for janitor-engineers.

4. Degree of Responsibility.—Just as there is usually an added increment, or a salary schedule on a higher plane, for principals than for teachers, so, for custodians or head janitors there should be an added increment, or a schedule on a higher plane than for assistants. This does not mean that the head janitor-engineer should have equal authority with the principal or that his salary should be based on the same schedule. It simply means that, so far as responsibility is concerned, the relationship between the head janitor-engineer and his assistants is comparable to that between the principal and his teachers and that this factor should receive recognition in the making of salary schedules for both groups.

The Daily Care of School-Building Floors

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FROM the many jobs included in the management of school buildings, one, the daily care of floors, has been selected for brief treatment in this article*. It is the almost universal practice to remove temporary dirt from the floors of school buildings daily. Methods of accomplishing this work are (1) to sweep the floors with a hair or bristle floor brush, (2) to wipe the floors with a soft cord or yarn floor mop that is specially treated, (3) to use a central or portable vacuum cleaner, or (4) to mop the floors with water. Use of the corn broom is so obsolete as a method that it need be given no consideration.

1. Frequency.—Whatever the method used, floors, when in use, must be cleaned daily. In locations where, and seasons when, mud is tracked into buildings, the floors of corridors and stairs that are most used need to be cleaned twice each day.

2. Time of Cleaning.—The only practicable time for cleaning classroom floors is after the dismissal of school in the afternoon. There is no time during the day when classroom floors can be cleaned and there are other necessary jobs that require all time available before the beginning of the morning session. Corridors and stairs, however, should be cleaned, by dustless methods, while children are in classrooms. This is likewise true of special rooms if there are periods during the day when they are not in use. The cleaning of from one-fourth to one-half of the total area of school-building floors during school hours will allow sufficient time for the thorough cleaning of classroom floors after school hours.

3. Effect of Kind of Furniture.—Tests show that the work of cleaning floors will be facilitated if classrooms are equipped with single pedestal combination desks and seats. Such furniture allows easy access to the floor under desks and seats from either side and, by eliminating troublesome corners around desk legs, makes, for purposes of sweeping, what amounts to a widened aisle. Four-leg combination desks and seats permit of the entrance of a floor brush between desks, but it is impossible to use an ordinary floor brush under four-leg desks with four-leg seats. Four-leg desks with pedestal seats are quite satisfactory furniture under which to sweep. It is impossible to sweep under the ordinary type of movable chair-desks, and much time is required to move the furniture of each room for daily cleaning. However, this type of furniture is advantageous in the periodic work of scrubbing and preserving floors.

4. Tools for Cleaning Floors.—Since the most common method of daily cleaning is the sweeping of floors, it is important that the right kind of floor brush be used. Fiber "bristles" bend and break and rapidly deteriorate. The all horse-hair "bristles" are too soft and pliable to move dirt, and they lack the necessary resiliency to free themselves of dust. Brushes made of a good grade of Russian bristles, with horse-hair out-bristles, cost about twice as much as the poorer grades but will give more than twice as much service, and will accomplish more effective results. The bristles should be thickly packed and firmly cemented into the brush block. They should be about 3½ inches in length for wood floors and about half that length for rough cement floors of basements or sidewalks.

The brush block should be from 14 to 18 inches long, depending upon the size and style of classroom furniture. Even for sweeping the floors of unfurnished rooms and corridors, brushes should not be more than 18 or 20 inches in length. Brushes of 30 or more inches are more difficult to lift at the completion of each stroke and have a tendency to turn slightly in the hand as they are lifted, so they cannot be dropped evenly to the floor.

Each janitor should have his individual floor brush. Handles should be made exactly the right length so that when the janitor holds the brush properly for sweeping, that is, with one hand at the end of the handle, and the other hand palm downward at a lower place on the handle, the

* More elaborate treatment of this and other cleaning jobs, as well as of the heating, ventilating and special work, and certain administrative phases of the care and operation of school buildings, may be found in the following reference: Reeves, Charles Everand, and Ganders, Harry Stanley: "School Building Management." Bureau of Publications, Teachers College, Columbia University, New York. 1928.

brush block will be parallel with the floor and the center bristles vertical to it. This means that handles should be cut at different lengths for different janitors, depending upon their height. Brushes should have reversible handles, and the handles should be occasionally changed so that the brush will wear evenly.

The treated floor mop can be used only for wiping floors that are waxed or treated with a very thin coat of light, high-grade floor oil. Even then it can be used only if floors are comparatively free from dirt, as may be the case where playgrounds are well drained and well surfaced. Where the floor mop is used, it is pushed along the floor, lengthwise of the boards wherever possible, the dust adhering to the yarn strands. The dust must be shaken from the mop and removed with a dustpan. Where this method can be effectively used, about 33 per cent of the time required for cleaning floors will be saved, but it fails completely in cleaning the floors of rooms that are very dirty.

The wet mop is used but little for the daily cleaning of floors. It is commonly used for the cleaning of toilet-room floors, and sometimes for the cleaning of corridor floors. For the cleaning of terrazzo, filled cement, or other hard-surfaced floors, mops can be used more effectively than floor brushes, but if they are used on wood floors, the daily application of water will, in time, swell and warp the boards, widen the cracks, and make the surface of the floor rough. Where mops are used, long-handled cord mops are best, the cord filler being kept clean and pliable and occasionally renewed. A wringer of the bull-dog type, securely fastened to a wood pail, will save time and be more effective than the wringing of mops by hand.

Vacuum cleaners, if of the right kind, are the most effective method to use in the daily cleaning of most school-building floors. Lack of space forbids a discussion of effective vacuum equipment. The advantages of central vacuum cleaning will be briefly outlined later.

5. Treatment of Floors.—Floors of school buildings are treated (1) to keep dust from rising during the sweeping process, (2) to improve their appearance, and (3) to preserve them from deterioration due to the use and frequent application of water in cleaning. Application of wax or a high grade of mineral floor oil will give the best possible appearance to a floor and will be the best preservative against wear, and, if properly cleaned, floors will never need the application of water. If mineral oil is used, it should contain paraffin, and the vaselin constituent should have been removed. Oil of any kind is the most effective means of keeping dust from rising, though wax is also quite effective. The use of treated sweeping compound should be limited to floors of composition, cement, etc., and to wood floors from which oil has been worn and which cannot be re-oiled until the following vacation period. It should never be used on waxed floors and is not needed on freshly oiled floors. Linseed oil, varnish, and paint, while being excellent preservatives, will be wholly ineffective in preventing dust from rising during the sweeping process.

Most school-building floors are oiled, with a high or a low grade of floor oil. Wax is coming into more popular favor as a treatment. If oil is used, the treatment should, in most schools, be applied three times a year. This will depend upon the number of pupils compared to the size of building, the condition of the playgrounds, and the like, but since the work of oiling floors can be accomplished only at the vacation periods, if it is omitted at the Easter vacation there will be a long stretch between the Christmas and summer vacations in which the oil will be used, so the floors will become very dry. Moreover, they will be in the poorest condition in the spring season, just when most dirt is carried into the building. If the floors are waxed, the treatment should also be applied at the three vacation periods, though it is possible to thoroughly wax floors once each year and to "touch them up" with wax in aisles, under desks, and in corridors, every two or three weeks.

The results of sweeping are far better on oiled than on unoiled floors. The results of sweeping have been graded as to quality, according to definite criteria, on a five-point scale, 1 being "excellent" and 5 "very poor." The results of sweeping were as follows:

33 unoiled classrooms, average grade, 4.3 (poor).
129 oiled classrooms, average grade, 2.0 (good).

The 129 oiled classrooms were then divided into those from which much of the oil had been worn and those that were still well oiled. The results of sweeping were as follows:

58 poorly oiled classrooms, average grade, 3.2 (fair).
71 well oiled classrooms, average grade, 1.1 (excellent).

6. Methods of Procedure in Sweeping.—Both the effectiveness of results and the time required for sweeping are largely dependent upon the methods of procedure used. Of seven methods of procedure for sweeping classroom floors, observed in actual use by janitors, and ten methods of procedure tested in experiments, under both large and small desks, the most rapid and most effective method proved to be the following:

Dirt is pushed ahead up one aisle, while at the same time it is pushed out from under desks on the right (or left, for an operator who holds the top of his brush with his left hand) into the aisle on the opposite side. The operator then walks back to sweep, in similar manner, the aisle into which the dirt from under the first row of desks has been swept. This process is continued until the work is completed.

Lack of space forbids the description of the other methods of procedure included in the observations and experiments, but principles of effective sweeping, abstracted from these methods and the one described above, may be listed as follows:

a. The operator should sweep under desks on but one side of an aisle at each trip through aisles.

(1) In sweeping under desks on both sides of an aisle the brush must cross over in front of the operator half of the time. This shortens the reach and makes the brush work less freely because too close to the operator's body.

(2) If the operator sweeps under but one row of desks, his body will remain in approximately the same relative position. In sweeping under desks on both sides he must continually change the position of his body and the direction of his strokes. This takes time, makes systematic and uniform strokes impossible, and results in less accurate placement and guidance of the brush.

b. The operator should choose to sweep under the row of desks such that the brush will be between him and the desks. The same reasons apply as in the case above.

c. The operator should always push the brush, never pull it. When the brush block is dropped farther away from the operator for the pulling stroke, it is not dropped so lightly and the movement is not in the direction in which it is to move after it reaches the floor, and brush marks are the result. When pulling strokes are used, there is also the disadvantage arising from pulling dust on the operator's feet.

d. The operator should not alternate pulling strokes from under desks with pushing strokes in aisles. By this method dust adhering to one side of the brush will drop off when the kind of stroke is changed.

e. The operator should not, after sweeping one aisle and under desks, sweep dirt around the row of desks into the next aisle, and along up the aisle as he cleans it. This necessitates sweeping along a greater amount of dirt on each return trip and increases the difficulty of keeping the accumulated dirt in the center of the aisle.

f. The operator should always move forward while sweeping. Backward movement is more difficult and time-consuming than movement forward as the eyes are directed.

Procedures in sweeping unfurnished rooms, corridors and stairs cannot be considered in this brief article, but there are both right and wrong methods of sweeping such areas.

Vacuum Cleaning

While the majority of school buildings are not at present equipped either for central or for portable vacuum cleaning, there is a growing tendency to equip new school buildings with complete central vacuum cleaning systems. Space cannot be given here to a consideration of features of such systems that are necessary or desirable for their effective operation, nor to methods of procedure in operating vacuum equipment, nor to conditions under which vacuum cleaning can best be used. Studies of these phases of vacuum cleaning have been made and are treated in the book, "School Building Management," to which previous reference has been made. The present discussion will be limited to a brief presentation of data showing the comparative value of cleaning floors by means of the central vacuum system and the floor brush.

To determine the efficiency of results and the time required by use of the central vacuum cleaner and the floor brush, both observations and experiments were made. Definite criteria were set up for judging results, and the effectiveness of work was graded on a five-point basis, as previously explained. Grades were assigned, and the time required was noted for both types of work, both in observations and in controlled tests.

Observations consisted of the cleaning, by means of floor brushes, of 128 classrooms by 16 different janitors, and of the cleaning, by vacuum, of 128 classrooms by 13 different janitors. The results were, for purposes of computation, reduced to a comparable floor area basis. The janitors observed were all engaged in their regular work, had been observed at other work during the days on which observations were made, and did not know the purpose of the observations. The results are shown in Table I.

TABLE I

COMPARISON OF THE EFFICIENCY OF RESULTS OF CLEANING CLASSROOM FLOORS BY MEANS OF THE CENTRAL VACUUM CLEANER AND THE FLOOR BRUSH

Frequency of grades assigned to the results of classroom cleaning, 1 being the best, and 5 the poorest, quality of results.

Central Vacuum Cleaner			Floor Brush		
Grade	Number of Cases	Per Cent Receiving Each Grade	Grade	Number of Cases	Per Cent Receiving Each Grade
1	76	59.4	1	36	28.1
2	50	39.0	2	25	19.5
3	2	1.6	3	13	10.2
4	0	0.0	4	28	21.9
5	0	0.0	5	26	20.3

Average grade for central vacuum cleaner 1.4
Average grade for floor brush 2.9

The average grades, 1.4, between "good" and "excellent" for vacuum cleaning, and 2.9, or about "fair" for cleaning by means of the floor brush, indicate that better work is usually accomplished by means of the vacuum cleaner.

In tests that were made, under controlled conditions, on unoiled floors, the results varied even more widely, the grades for vacuum cleaning being 1, or "excellent," and for brush cleaning, 4, or "poor."

The differences in grades assigned both to observations and experiments, may be explained in the following facts:

a. The central vacuum cleaner covers space in out-of-the-way places, such as under radiators, around desk legs, and the like, much better than will the floor brush.

b. The vacuum cleaner does not leave tool marks on the floor, as is often the case where the floor brush is used.

c. The vacuum cleaner does not stir up dust

to float in the air, as does the floor brush on unoiled or poorly oiled floors.

d. The vacuum cleaner removes dust from cracks which the floor brush cannot reach.

With these advantages for properly removing dirt and dust, it would be reasonable to suppose that more dirt would be removed from rooms by use of the central vacuum cleaner than by the floor brush. Two experiments were conducted, under controlled conditions, to determine whether this were true. In each experiment four rooms were cleaned by vacuum and four by means of the floor brush. In each experiment the tests were made by one janitor using both methods, on the same day, on the same floor level, the rooms being occupied by approximately equal numbers of children of the same grades. All rooms had previously been cleaned by vacuum twenty-four hours previously, so they should have contained approximately the same amount of dirt. All other significant factors were either the same or were equalized. The results were as follows:

First Experiment

Amount of dirt (corrected by reduction for greater floor area) obtained from 4 rooms cleaned by means of the central vacuum cleaner, 2 pounds, 12 ounces.
Amount of dirt obtained from 4 rooms cleaned by means of the floor brush, 1 pound, 12 ounces.
The vacuum cleaner, therefore, removed 157 per cent as much dirt as did the floor brush.

Similar results were obtained in the second experiment. They follow:

Second Experiment

Amount of dirt removed by vacuum from 4 rooms, (2,796 square feet), 3 pounds, 8 ounces.
Amount of dirt removed by brush from 4 rooms, (2,796 square feet), 2 pounds, 2 ounces.
The vacuum cleaner, therefore, removed 165 per cent as much dirt as did the floor brush.

In consideration of all of the above data, there can be little question but that the central vacuum cleaning system is more effective than the floor brush as a means for cleaning classroom floors.

Less definite data have been secured concerning the time required to clean classrooms by means of the central vacuum cleaner and the floor brush, but what are available point to the conclusion that use of the central vacuum cleaner is slightly more rapid than use of the floor brush. The time required to clean by vacuum 128 classrooms by 13 different janitors, and the same number of classrooms by means of the floor brush by 16 different janitors, was an average of 7 minutes, 26 seconds per classroom (reduced to 700 square feet) cleaned by vacuum, and 8 minutes, 47 seconds per classroom (reduced to 700 square feet) cleaned by means of the floor brush. This shows a saving of 1 minute and 21 seconds for rooms cleaned by vacuum.

Under controlled conditions, the differences were less, but still in favor of vacuum cleaning. One janitor saved 58 seconds, and another but 7 seconds, per room in cleaning by vacuum.

The use of a central vacuum cleaner for cleaning classroom floors is probably slightly more rapid than the use of a floor brush. Observations of janitors at work lead the writer to believe this to be unquestionably true where janitors have learned the better methods of procedure in vacuum cleaning. Where janitors use the poorer methods of procedure, and have not learned the real technique of handling the apparatus, it is likely that use of the brush may be slightly more rapid. The operation of a vacuum cleaner is work at which an intelligent janitor can obtain a high degree of skill. Correct methods of procedure in vacuum cleaning have been analyzed by the writer but are not presented in this article.

Even if there is but a small saving in time through use of the central vacuum cleaner, the more effective results to be obtained, as have here been briefly presented, make it advisable for those who have the planning of school buildings to carefully consider the cost and practicability of piping buildings and installing the equipment for vacuum cleaning. It would also be well for school authorities to consider the many other uses of a vacuum cleaning system, though none are more important than the daily cleaning of floors. Furthermore, if a system is to be installed, it must be one that will be effective, and janitors must be trained to use the equipment properly, or, instead of being an effective aid to the daily cleaning of floors, at a saving of time and energy on the part of janitors, its use will be abandoned, as some have been, for the older and more common method, requiring less skill, that of cleaning floors by means of the floor brush.

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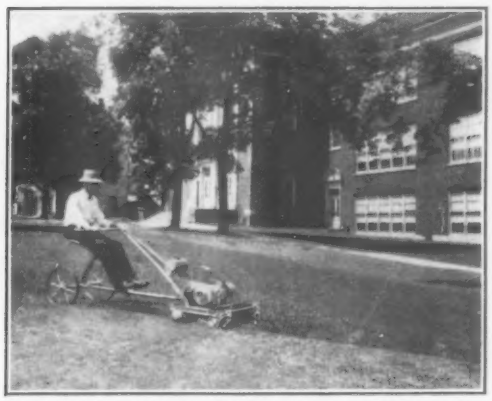


"TWIN THIRTY" WITH RIDING SULKY ON HIGH SCHOOL GROUNDS

"L" TWIN WITH GANG ATTACHMENT ON DORMITORY GROUNDS AT VASSAR COLLEGE

"TWIN THIRTY"

Rolls and **mows** simultaneously six to eight acres per day. Has full 30-inch, two-section drive roller with differential between rollers to prevent marking and make turning easy. 30-inch, 5-blade cutter.

Equipped with **two-cylinder,** four-cycle, water-cooled motor which provides an abundance of reserve power, is free from vibration and noise and will develop maximum power continuously in hottest weather without overheating.

Riding sulky for the operator, also grass catcher may be had as extra equipment.

Extremely useful where athletic fields are to be maintained.

"L" TWIN

Rolls and **mows** simultaneously four to six acres per day. Full 25-inch, two-section drive roller with differential. 25-inch, 5-blade cutter.

Two-cylinder, four-cycle, water-cooled motor supplies unusual reserve power.

This model may be had with the two 20-inch auxiliary gang units which increases the swath to 60 inches and more than doubles the capacity. Very useful for the wide open stretches of lawn.

In the "L" Twin is combined extreme flexibility for trimming and terrace work; a 25-inch combined mower and roller or separate roller and, with the gang attachment, a mower of exceptionally large capacity.

Riding sulky for the operator, also grass catcher may be had as extra equipment.

"L" JUNIOR

Rolls and **mows** simultaneously four to six acres per day. Full 25-inch, two-section drive roller with differential. 25-inch, 5-blade cutter.

A powerful, single-cylinder, four-cycle, water-cooled motor drives this light weight mower and roller, furnishing plenty of power for use on grades and in tough grasses. Simple and sturdy in design and construction and moderate in price. Thoroughly dependable and extremely economical in operation.

Grass catcher may be had as extra equipment.

"CUB"

Rolls and **mows** simultaneously three to four acres per day.

Full 21-inch, two-section drive roller with differential. 21-inch, 5-blade cutter.

A light weight, simple, economical and dependable power mower and roller at a very moderate price. Especially well suited for lawns surrounding the smaller schools and also very useful for trimming and cutting the small plots on the larger campuses.

Equipped with a 4-cycle, water-cooled motor having unusual power for the size and weight of the machine. Unexcelled for hilly lawns.

STANDARD FEATURES IN ALL COLDWELL MODELS

Full-width Drive Rollers
Four-cycle, Water-cooled Motors
All machines complete, including the motor, designed and built in the Coldwell factory
Timken tapered roller bearings throughout
Alemite-Zerk force feed lubrication
Oil tempered, self-sharpening blades
Automatic spring loaded clutches require no adjustment
Combined rolling and mowing, or separate rolling when desired
Thoroughly dependable, trouble-free, economical operation over a period of years
A large selection of styles and sizes and at prices assuring the greatest possible value
A Complete Dependable Line of Hand, Horse and Power Lawn Mowers

SINCE 1867
COLDWELL
DEPENDABLE LAWN MOWERS
Hand—Horse—Gasoline—Electric

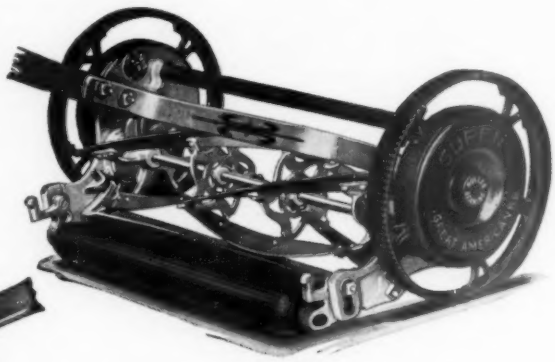
PENNSYLVANIA LAWN MOWER WORKS

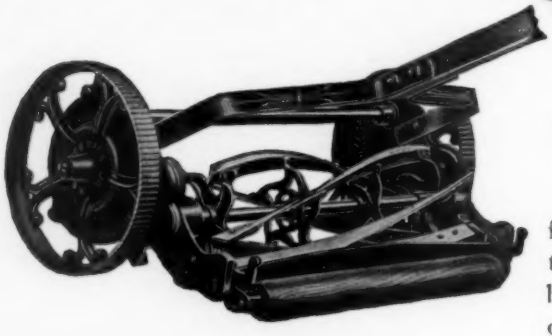
1615–35 North 23rd Street, Philadelphia, Pa.

Manufacturers of

ALL TYPES OF MOWERS—HAND-TYPE, HORSE-DRAWN, TRACTOR-DRAWN—FOR USE ON PUBLIC PARKS, GOLF COURSES, CEMETERIES, LARGE ESTATES AND SMALL LAWNS

There is a Pennsylvania Quality Mower for every grass-cutting purpose and they all embody more than a half century of experience in the development and production of quality lawn mowers. Our latest COMPLETE CATALOG, describing the entire Pennsylvania Quality line, will be sent promptly on request.





PENNSYLVANIA JUNIOR
(Ball-Bearing)

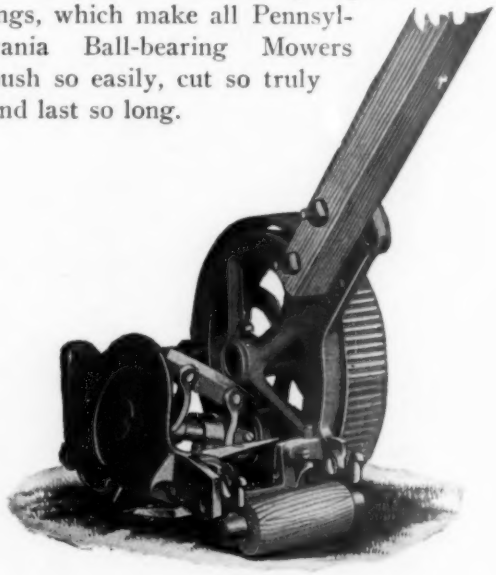
This is the hand mower that has established the reputation of Pennsylvania Quality in all parts of the world. Its self-sharpening features alone make it worth its cost to the user, because they save the expense of sharpening until the blades are worn out—in average use, a dozen years or more.

PENNSYLVANIA UNDERCUT BALL-BEARING TRIMMER

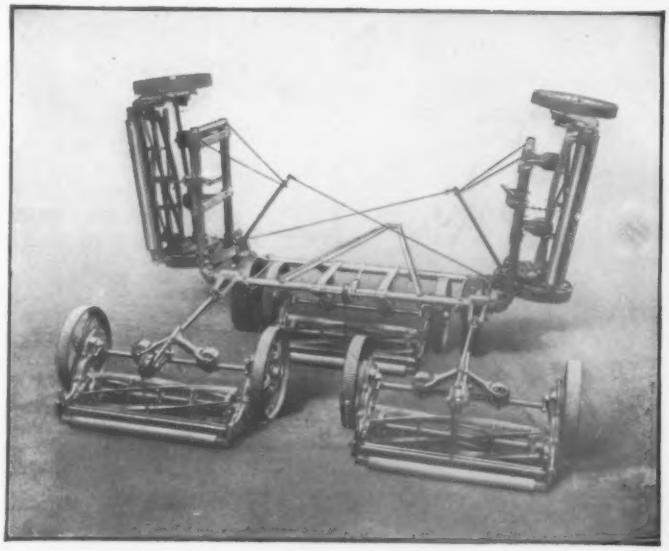
The unique construction of the Undercut Trimmer permits cutting, not only close up to a wall, fence or tree but, also, **under** a fence, beneath house foundations and in other places hitherto beyond the reach of anything but hand shears.

SUPER GREAT AMERICAN BALL-BEARING (Roller-Bearing Wheels)

There is no better mower made, either for the home lawn or for gardener's use, than this improved model with its roller-bearing wheels and steel axles. The cylinder of the SUPER Great American runs on the new Braun Self-aligning Ball Bearings, which make all Pennsylvania Ball-bearing Mowers push so easily, cut so truly and last so long.

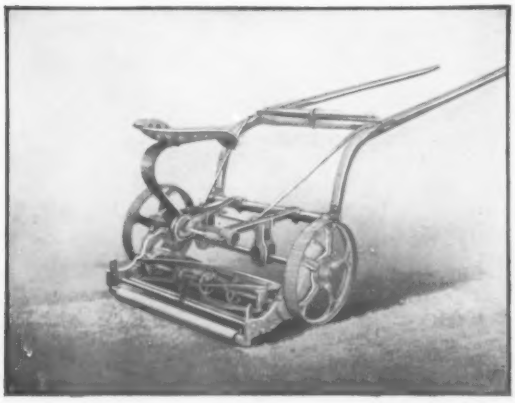


THE LIGHTER, SIMPLER PENNSYLVANIA TRACTOR-DRAWN "NEW" FAIRWAY QUINT AND TRIO



Although the tractor-drawn Pennsylvania "New" Fairway Mower retains all the features that have won an international reputation for the Pennsylvania Super Fairway Quint and Trio, it is lighter than the Super Fairway, simpler in design and lower in price. It has been so simplified that even the average tractor operator can readily make all adjustments and any minor repairs.

Write for complete details and for SPECIAL GOLF CATALOG.



PENNSYLVANIA FAIRWAY PONY MOWER
(30-inch Cut)

This Pennsylvania Quality machine, which consists of one of the units of the nationally known Super Fairway gang mower fitted with seat and shafts, is an outstanding improvement over older types of horse mowers of roller design. Its lighter construction and larger wheels result in reduced draft; it has greater adjustability for height of cut; it is equipped throughout with quality roller and ball bearings, and has an idling device similar to that used on gang mowers. Complete details sent on request.

PENNSYLVANIA LAWN CLEANER AND RAKE

With this machine one boy can do as much work as three or four men with rakes. Its rapidly revolving rakes act like a vacuum cleaner on the lawn, removing cut grass, leaves and other foreign matter that keeps sunlight and dew from the roots. It is also made with brushes for lawn sweeping and for golf greens.

THE FATE-ROOT-HEATH COMPANY

876 Bell St.

PLYMOUTH, OHIO

THE PEERLESS MOWER SHARPENER

The Peerless Mower Sharpener is a remarkable invention that sharpens all makes of power and hand lawnmowers and cutting units scientifically, quickly, perfectly, doing the work as nothing else can.

One of the big expense items of a well-kept athletic field, campus or golf course is the cost of sharpening mowers and cutting units. Whether you sharpen your own, or have it done outside, you can save money by adopting the modern method—the Peerless Mower Sharpener. It not only **saves money** by sharpening mowers in one-half the time, but does the work **so much better** that there is really no comparison.

If you are using files, it is slow and expensive, as most mowers are now made with hardened blades.

A FEW OF THE HUNDREDS OF USERS OF THE PEERLESS MOWER SHARPENER

Brentwood Country Club....Los Angeles, Calif.
Baltusral Golf Club .....Baltusral, N. J.
Columbus Country Club .....Columbus, Ohio
Cherryhill Club .....Denver, Colo.
Country Club, The .....Salt Lake City, Utah
Colo. State Teachers' College.....Greely, Colo.
Culver Military Academy.....Culver, Ind.
Great Lakes Naval School....Great Lakes, Ill.
Galveston Country Club .....Galveston, Tex.
Highland Country Club.....Pittsburgh, Pa.
Inwood Country Club .....Inwood, N. J.
Inverness Club .....Toledo, Ohio
Kahkwa Club .....Erie, Pa.
Kalamazoo Country Club .....Kalamazoo, Mich.
Kenyon College .....Gambier, Ohio
Lansing Country Club.....Lansing, Mich.
Merion Cricket Club .....Philadelphia, Pa.
Nat'l Golf Links of America..Southampton, N. Y.
Naval Training Station.....Newport, R. I.
Northfield Seminary .....Northfield, Mass.
Northwestern University.....Evanston, Ill.
Olympia Fields Country Club ....Matteson, Ill.
Pinehurst Country Club .....Pinehurst, N. C.
Piping Rock Golf Club....Locust Valley, N. Y.
Port Arthur Industrial School..Port Arthur, Tex.
Ridgewood Golf Club .....Cleveland, Ohio
Rochester Municipal Corp.....Rochester, N. Y.
Rutgers College.....New Brunswick, N. J.
Skokie Country Club .....Glencoe, Ill.
Somerset Country Club .....St. Paul, Minn.
Seattle Golf Club .....Seattle, Wash.
Stambaugh Township Schools..Stambaugh, Mich.
Swathmore College .....Swathmore, Pa.
Tome School (The).....Port Deposit, Md.
Winter Park Golf Club .....Winter Park, Fla.
Westchester-Biltmore Club .....Rye, N. Y.
Youngstown Country Club...Youngstown, Ohio
Tedesco Country Club .....Swampscott, Mass.

If you use emery dust you reduce the clearance behind the cutting edge; the mower runs hard and **tears** the grass instead of shearing.

The Peerless Sharpener produces a perfect cutting edge, with the **proper clearance** or bevel. Mowers run easier, less power is required, hence more speed is obtained. Grass is **sheared** off—not chewed off or pulled out by the roots.

Simple to Operate—Equipped with a ⅓-H.P. motor—attach to your light socket. Place the mower in position, make a few simple adjustments, turn on the power, and in a few minutes you have a cutting unit with a razor-like edge. The Peerless Sharpener sharpens all makes of power, horse or hand mowers perfectly. It is equipped with special grinding wheel for grass shears, hedge shears, sickles, etc., and an attachment for sharpening all makes of skates, including hockey. It can be used the whole year 'round.

We have a handsomely illustrated catalog awaiting your request. Write today—now—and learn the full possibilities of this wonderful machine.

IDEAL POWER LAWN MOWER COMPANY

MAIN OFFICE AND FACTORY

LANSING, MICHIGAN

FACTORY BRANCHES

237 Lafayette St., New York 413 W. Chicago Ave., Chicago 161 Vester St., Ferndale (Detroit), Mich.

POWER LAWN MOWERS FOR SCHOOLS AND COLLEGES

IDEAL "TWENTY-TWO"

Combination power mower and roller. Width of cut 22 inches. Capacity, 3 to 4 acres per day. Magneto ignition. Five blade reel. Weight 430 lbs. Recommended for the average small city, village or consolidated school grounds.

IDEAL "TWENTY"

Designed for mowing lawns that are too large to care for conveniently with hand mowers. Also for use on lawn with steep grades. Width of cut 20 inches. Capacity, 1 to 3 acres per day. Flywheel magneto. Control clutch on mower handle. Speed, 1 to 4 miles per hour. Five blade reel. Very simple adjustment. Weight 245 lbs.

IDEAL "THIRTY"

Roller type. Width of cut 30 inches. Capacity, 5 to 7 acres per day. Magneto ignition. Five blade reel. Weight, 630 lbs. For large grass areas around schools and colleges. Rolling feature very valuable for athletic fields, ball grounds, tennis courts, etc.

IDEAL "TWENTY-FIVE"

Recommended for mowing lawns that are interspersed with trees, walks, shrubs and where necessary to mow on grades and hillsides.

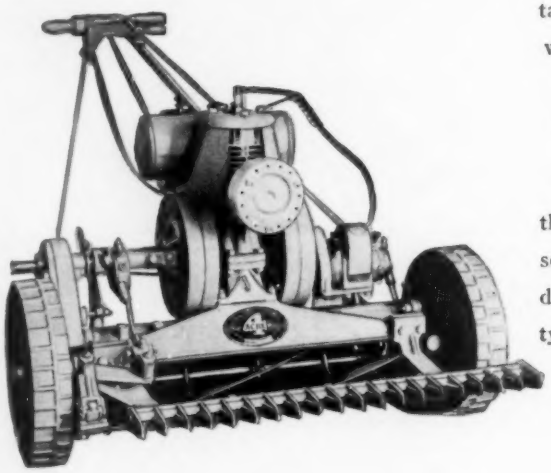
Width of cut 25 inches. Capacity, 4 to 6 acres per day. Flywheel magneto. Two clutches on mower handles, one for the drive wheels and one for cutting reel. Weight 310 lbs.

JACOBSEN MANUFACTURING COMPANY

RACINE, WISCONSIN

THE "4-ACRE" POWER LAWN MOWER

Schools and universities take a great deal of pride in their lawns. Mowing these spacious lawns, campuses and playgrounds is greatly simplified by Jacobsen Mowers.



The "4-Acre" Mower cuts a 24-inch swath at the rate of four acres a day—work that would require 4 or 5 men with push-type mowers. It produces a smooth, velvety lawn, negotiates terraces, and the automobile-type differential makes it steer easily about trees and other obstructions. The sturdy, especially-built gasoline motor consumes about a gallon of gas a day.

GEAR DRIVE

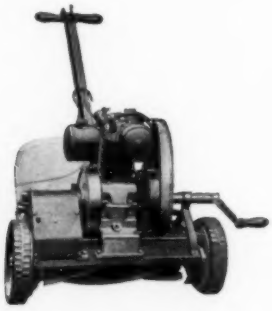
There are no chains, no sprockets on the Jacobsen Mower. It is driven by gears enclosed in double, oil-tight housings. The cutting reel and traction unit have independent clutch controls. The knives are sharpened by the mower's own power.

CLIPPING ATTACHMENT

The "4-Acre" Mower may be had with or without Sickle-Bar Clipping Attachment. The Clipping Bar sets ahead of the regular cutting reel and may be operated independently or simultaneously. It cuts tall, tough grass, dandelions, plantain, buckhorn and other destroyers of lawn beauty which are beyond the scope of the cutting reel.

THE "JUNIOR" 19-INCH POWER MOWER

This quality power mower has less capacity than the "4-Acre" Model but is suitable for high-school lawns or any moderately large lawn. It does the work of two or three men with push-type mowers, steers easier than a hand mower and is equipped to sharpen the knives by the mower's own power.

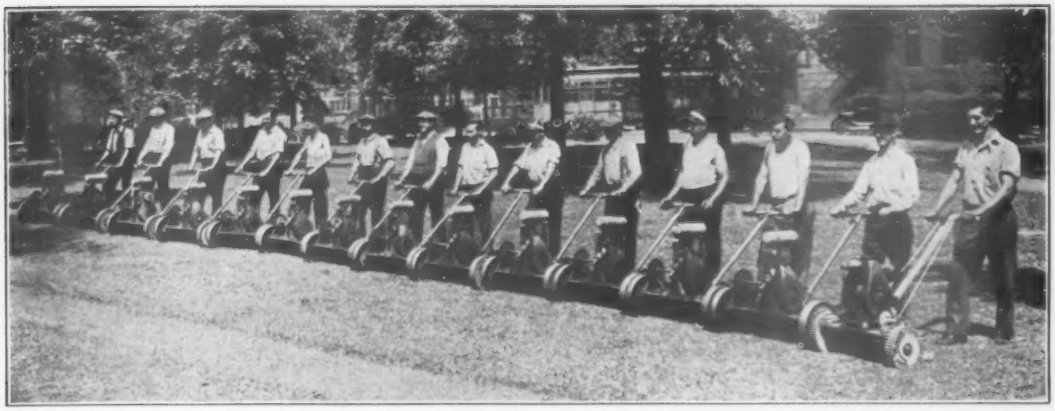


All Jacobsen Mowers are the product of experience; known and used for years throughout the country and have won an enviable reputation for simplicity, sturdiness and dependable performance. Rigidly guaranteed. Demonstrations on your own grounds without obligation.

Write Dept. SS for descriptive literature and prices.

THE MOTO-MOWER COMPANY

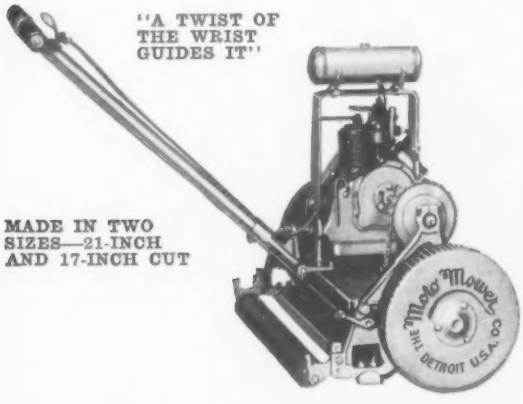
3246 E. Woodbridge St., Detroit, Michigan



ONE BATTALION OF THE BATTERY OF FORTY MOTO-MOWERS USED BY THE DEPARTMENT OF PARKS AND BOULEVARDS, CITY OF DETROIT

MOTO-MOWER FOR GRASS CUTTING EFFICIENCY

The Moto-Mower is a simple, compactly designed, moderately priced power lawn mower; light enough to be easily run up and down and over your terraces; small enough to cut close to trees, hedges and flower beds, which eliminates trimming by hand; economical in gasoline and maintenance and so fool-proof that almost anyone can be trusted to run it without danger of its getting out of order. Furthermore, it is a machine that will do a big day's work of ordinary straightaway cutting on open lawns.



The simplicity of operation of the Moto-Mower is a revelation. It starts, stops and turns in any direction under its own power by the mere rotation of two rubber grips on the handle; no physical effort is required.

In cutting around trees and shrubbery, it is often advantageous to operate the Moto-Mower at a somewhat slower speed than on the straightaway, and again in the cutting on hilly ground additional power is often required. The throttle control mounted on the handle allows the operator to vary the speed of the machine as conditions require. Regardless of how fast or how slowly the Moto-Mower travels over the ground it will cut the grass with equal efficiency.

LIGHT WEIGHT

Practically the entire mower unit is made of malleable iron and steel. Thus we have been able to keep lightness of weight, together with great strength and durability. Light weight means small gas consumption, and easy handling.

Further details may be obtained by writing for our illustrated booklet.

NAPERVILLE NURSERIES

Growers and Distributors of

Ornamental Trees, Shrubs, Vines, Evergreens and Perennials

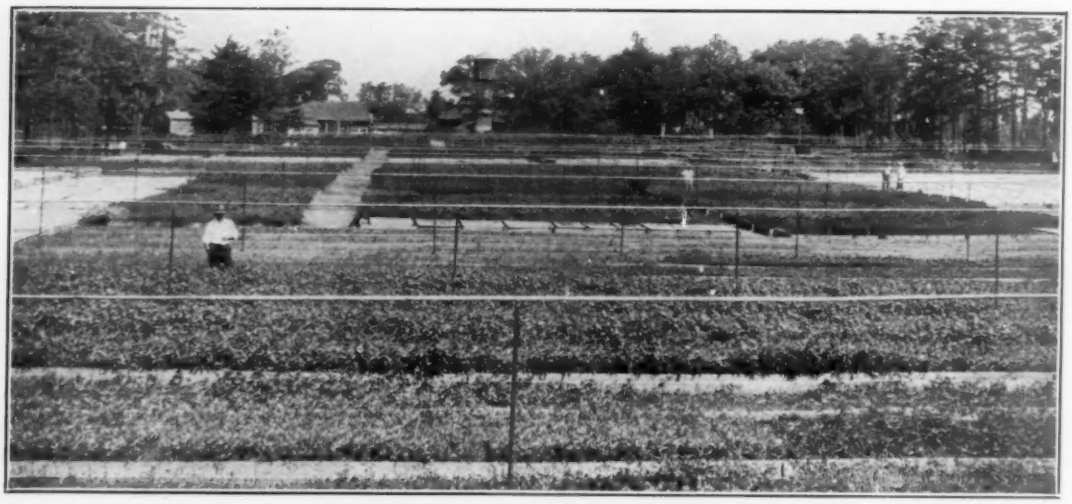
For Parks, Golf Grounds, Country Clubs, Estates, Cemeteries, Subdivisions, Landscape Plantings, Horticultural and Forestry Projects

NAPERVILLE (Du Page County) ILLINOIS

28 MILES WEST OF CHICAGO ON STATE ROAD 18 (OGDEN AVENUE)

Established 1866 — Phone: NAPERVILLE 1

ACRES OF TRANSPLANTED SHRUBS—SNOWBALLS IN FOREGROUND



SECTION OF PROPAGATION DEPARTMENT

275 Acres Devoted Exclusively to the Growing of Nursery Stock.

We carry one of the largest and most complete assortments of transplanted nursery stock in the Central West. Catalog Upon Request.

STUMPP & WALTER CO.

30-32 BARCLAY STREET, NEW YORK CITY

Branch Stores in—Newark, N. J., White Plains, N. Y., Baltimore, Md.

Farms and Testing Gardens at Farmingdale and Islip, L. I.

High Quality Seeds, Bulbs, Plants, Equipment and Supplies

Stumpp & Walter Co

Grass Seed
of Known Quality

FOR GOLF COURSES, TENNIS COURTS,
POLO FIELDS, ATHLETIC FIELDS,
AIRPORTS, LAWNS, ETC.

All our seeds are of the highest quality, botanically true to name and are cleaned and recleaned, special care being given to the elimination of weed seeds.

We are always glad to advise in regard to formulas suited to soil and climatic conditions, treatment of soil, fertilizing, etc.

High Quality Bulbs

We are one of the largest growers and importers of American, Dutch, French and Japanese Bulbs for discriminating flower lovers in the United States.

Flower Seeds

All our seeds are of the highest quality and are carefully examined and tested at our trial grounds. We offer only those of superior strains and finest types.

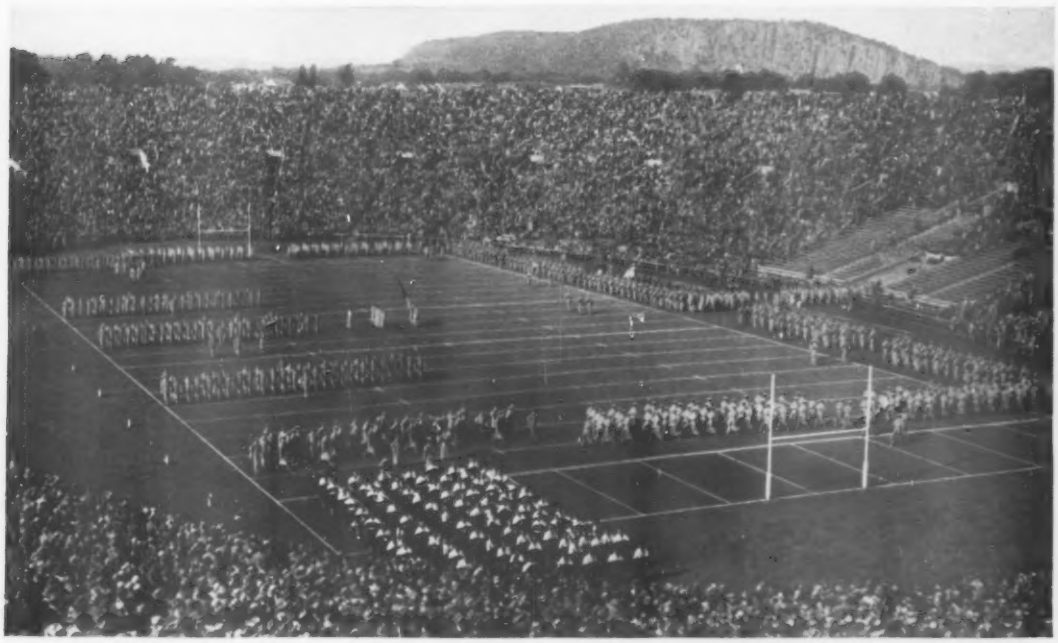
Vegetable Seeds

All our seeds are of the highest quality and we list only such sorts which from tests at our trial grounds we have found to be of superior merit and which we can recommend for both the market and home garden.

Equipment and Supplies

We are also agents and dealers in Tractors, Mowers, Rotary Soil Screens, Implements, Fertilizers, Insecticides and Sundry Equipment and Supplies.

Complete Catalog Sent on Request



The Yale Bowl at New Haven, Conn. Grass Seed for Yale Bowl, as well as for Yale Golf Course, Polo Field and Football Field, supplied by the Stumpp & Walter Co.

THE TROPICAL PAINT & OIL CO.

General Offices and Factories

1208-1250 West 70th St., Cleveland, Ohio

Warehouses in Principal Business Centers

TROPICAL

A Specialized Paint Service for Schools

For years we have specialized in the manufacture of Paints, Enamels, Varnishes and Roof Coatings for the protection of large buildings. During this time we have developed many coatings for Educational Institutions.

The Tropical Surface Saver

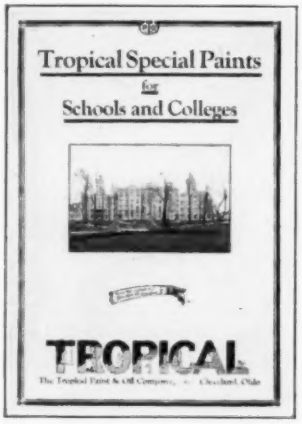
From an advertisement in The Saturday Evening Post.

Our whole energy is bent toward the improvement and development of our maintenance products. It pays to buy from specialists like ourselves, because you are sure of getting the most suitable coating for every surface and one which will give long wear and satisfaction.

We maintain a staff of men covering the whole country, who are known as "Tropical Surface Savers". They have been trained in paints and painting problems and know how to analyze painting conditions.

The "Tropical Surface Saver" in your locality will be glad to apply his knowledge to your problems. This is a service of which you can avail yourself free of charge.

This book, which is given free to school officials, was designed especially to help those who are responsible for the maintenance and upkeep of school buildings.

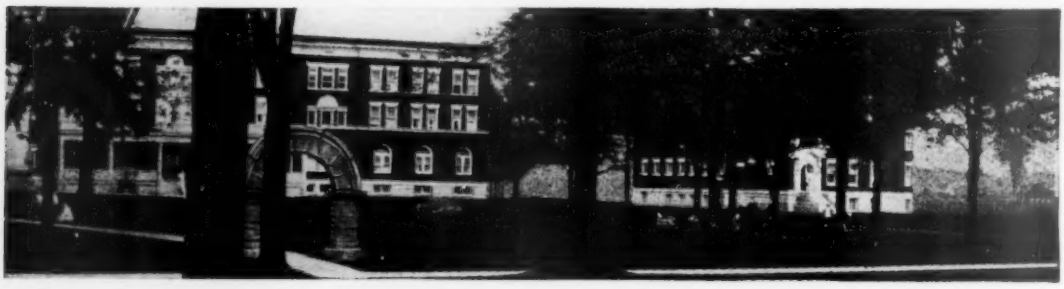


Among its pages you will find information about protecting and decorating difficult surfaces like swimming pools, shower rooms, laboratories and toilet rooms. It also contains pictures of many educational institutions where Tropical Protective Coatings are now in use, and descriptions of those products, which are designed for school buildings.

Another useful feature of this book is an alphabetical index of all surfaces that need protection around Educational Institutions, and opposite each is the name of the Tropical Product that is designed to decorate and protect that particular surface.

This book will make a valuable addition to your information file, as there are many times when you will find that it will come in handy.

Part of the buildings of the Edinboro State Normal School at Edinboro, Pa. Tropical Products have been used here since 1918

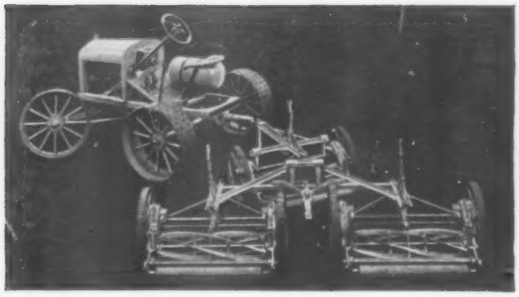


WORTHINGTON MOWER COMPANY

Manufacturers of Power, Gang, and Hand Mowers, Lawn Tractors and Golf Course Appurtenances

STROUDSBURG, PA.

AGENCIES IN ALL PRINCIPAL CITIES



WORTHINGTON LAWN TRACTOR AND TRIPLE MOWER COMBINATION

Shown turning on a radius 7½ feet wide. This outfit is capable of cutting an acre of ground in less than fifteen minutes. The swath of nearly eight feet may be increased to 11½ feet at any time simply by the addition of a third row frame and two cutting units. This attachment is made by means of a single king bolt. Tractor weight of only 1000 pounds eliminates all possibility of injury to turf.

WORTHINGTON OVERLAWN POWER MOWER

Composed of a complete tractor drawing a standard 30-inch fairway unit. Tractor motor is of Standard Indian Motorcycle construction. This machine has been especially designed for the mowing of restricted areas around trees, shrubs, etc. Turns on a radius of 2½ feet and is unequalled in freedom from derangement or delays.

Section III

GYMNASIUM, SWIMMING POOL, ATHLETIC FIELD AND PLAYGROUND

Outdoor Athletic Facilities at School and University

BY GAVIN HADDEN

CIVIL ENGINEER, NEW YORK

MODERN schools and universities recognize their obligations to furnish their students with instruction and training which has a twofold purpose—to train their minds and to train their bodies. *Mens sana in corpore sano.* To build up one without the other is an unsound and incomplete process. In another generation the training of the body was taken care of, in a haphazard way perhaps, by the individual and the home, and the school recognized no responsibility in the matter. Today, however, it is a rare home that has stock to care for, fields to plant, cows to milk, or, for the girls, bread to bake or cloth to weave. Modern civilization has removed from average boys and girls these activities which formerly filled their days, and the leisure time thus released will be inevitably occupied; all too often by the movie theater or the game of chance if no sounder substitute is provided. The schools must therefore do more than train the minds and bodies of students—they must provide sound and healthful substitutes to fill their recently enlarged leisure hours.

The Modern Idea of Physical Exercise

Side by side with the development of the facilities for mental education, therefore, there has been great development in facilities for physical education and recreation. Probably the greatest single manifestation of the latter development has been in the departure from the drudgery of mere physical exercise to the introduction and encouragement of athletic games. The average student will evade whenever possible the compulsory routine exercise of calisthenics, but let him engage in a competitive game with his fellows, and his intense interest is readily aroused. The great body of trained and experienced athletic directors now distributed through the schools and colleges of the country have demonstrated this fact clearly enough, and their problem now usually becomes one of obtaining adequate and varied facilities rather than one of inducing the students to take part.

Calisthenics and other similar activities that have for their only apparent purpose physical exercise, are being relegated more and more to the background; they are now used principally for corrective purposes. The present aim is to provide a sufficient number of facilities, of a widely diversified character, to enable each student to take part regularly throughout the year in those games that have the greatest appeal for him. The facilities thus provided divide themselves naturally into two classes, indoor and outdoor, and each has its special place and purpose in the solution of the physical education problem.

The primary purpose of indoor athletic facilities is to provide for the playing of games only during those periods when conditions of weather and temperature make outdoor play difficult or undesirable. It is generally recognized that outdoor play, during favorable weather, is more beneficial than indoor play, even when the latter is carried on under the most healthful and satisfactory conditions, but the average school or college year contains so many days of inclement or unfavorable weather that indoor facilities assume an importance nearly equal to that of outdoor facilities. The principal restriction that affects the provision of suitable indoor equipment lies in the cost of the construction of the buildings required to house them, while the principal restriction affecting the provision of suitable outdoor equipment lies in the cost or scarcity of the open land necessary for the desired games.

This paper is definitely restricted to a discussion of outdoor facilities, but it should be recognized that these are only a part—the major part perhaps—of the problem of equipment for physical education. Furthermore, in studying the requirements, and in devising the means to fill them, it is often advantageous to consider the indoor and the outdoor facilities together. It is no more logical to regard each of these classes of facilities

as a separate and independent matter than it would be to divide the administration of athletics or of physical education into two separated and independent departments, one for indoor activities and the other for outdoor activities. The writer has in his experience found it advantageous to combine in one study for simultaneous consideration both the indoor and the outdoor facilities for a given institution.

A Question That Should Be Asked

In determining the proper outdoor athletic facilities for a given school or university, the question should be asked: What facilities should be provided to give adequate and efficient equipment for the institution as a whole? All too often, unfortunately, on account of practical restriction, this question has been revised to read somewhat as follows: What facilities can be provided on the certain limited area of ground designated, this certain area being that which can be conveniently spared from other uses? Or the question may be still further restricted: What facilities can be provided on the certain area at a cost within a certain fixed limit? Some school boards, trustees and other administrators now recognize clearly the changes and developments which have taken place, and in spite of the restrictions imposed upon them wish to be told what facilities they should have and plan for, even if some considerable portion of these facilities must of necessity be omitted from their initial development and postponed until a future time. With such information a comprehensive plan can usually be devised and the athletic facilities can be extended and developed as land and funds become available, with a minimum of loss and waste.

What then, are the facilities which should be provided? No specific and generally applicable answer can of course be made. The reasonable general statement can be made, however, that any institution, school, college or university, should provide outdoor athletic facilities which will lie somewhere between the two following limits:

(a) Minimum: one standard field or court suitable for the play of each of the usually most desirable games during its proper season;

(b) Maximum: a sufficient number of standard courts and fields to allow every student to play each day that game which will be most desired or most beneficial during that part of each day which is most desired or most convenient.

These limits are of course extremely far apart, particularly for institutions with enrollments of considerable size. In each case many considerations must be examined and weighed and reasonable restrictions and limitations must be imposed on the diversity of choice of games or on the time available for play, or both. The specific kind and number of facilities to be provided can then be definitely recommended.

Suggested Outdoor Athletic Facilities for Typical Schools

As a guide to boards of education and their committees and executives in determining this question for high schools of various enrollments, the writer has prepared the following list of suggested outdoor athletic facilities based upon experience with conditions at a number of what may be regarded as typical schools.

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
School Enrollment	*Run'g-Tracks*	*Football Baseball Fld. Hockey Soccer Lacrosse, etc.*	*Tennis*	*Outdoor Basketball (girls)*	*Outdoor Handball*	*Athletic Lockers*
400	1 with 1 st.	2	2D	1	1	100
600	1 " 1 st.	2	2D–2S	2	2	150
800	1 " 1 st.	2	4D–2S	2	4	200
1,000	1 " 2 st.	3	6D–2S	2	4	250
1,500	1 " 2 st.	4	10D–2S	3	8	375
2,000	1 " 2 st.	6	12D–4S	5	10	500

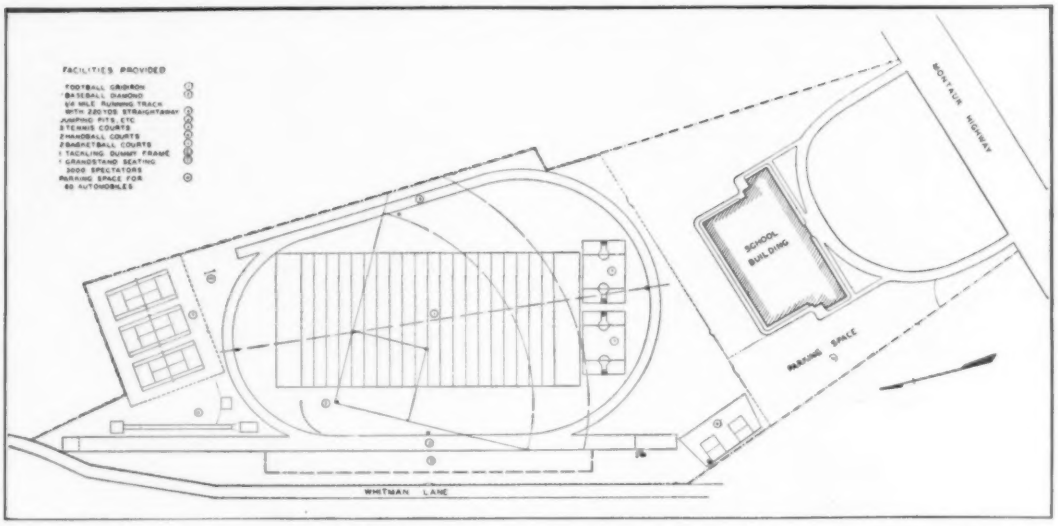
In the preparation of this list many general assumptions were of course necessary, and to apply it accurately to the conditions obtaining at any specific school, corrections must be made for any variations from the general conditions which have been assumed. Some of the important assumptions and requirements governing the list are:

1. For all enrollment figures (Col. 1) it is assumed that approximately one-half are boys and one-half girls; no deduction has been made for pupils requiring special corrective exercises (as is believed to be proper in determining indoor facilities), on the assumption that all should be given opportunity for outdoor play.

2. The major facilities (Cols. 2 and 3) are planned to provide for all the pupils who use them during the afternoons after regular school hours, as is customary, but if the fields, etc., are located near the schoolhouse, they may be used during regularly designated school periods also.

3. The minor facilities (Cols. 4, 5, and 6) are planned for use during school hours as well as during afternoon hours, assuming in general 10 periods per day for the "team" games and 15 periods per day for the "individual" games (tennis and handball).

4. The unit of size for running-tracks (Col. 2) is a ¼-mile track with 4 lanes, a 220 yds. straightaway ("st") with 6 lanes, and suitable runways, pits, etc., for the jumps, vaults, and other field events which accompany track games. Where 2 straightaways are provided, they may be combined to give a width of, say, 10 lanes. It is not always possible to provide full ¼-mile running-



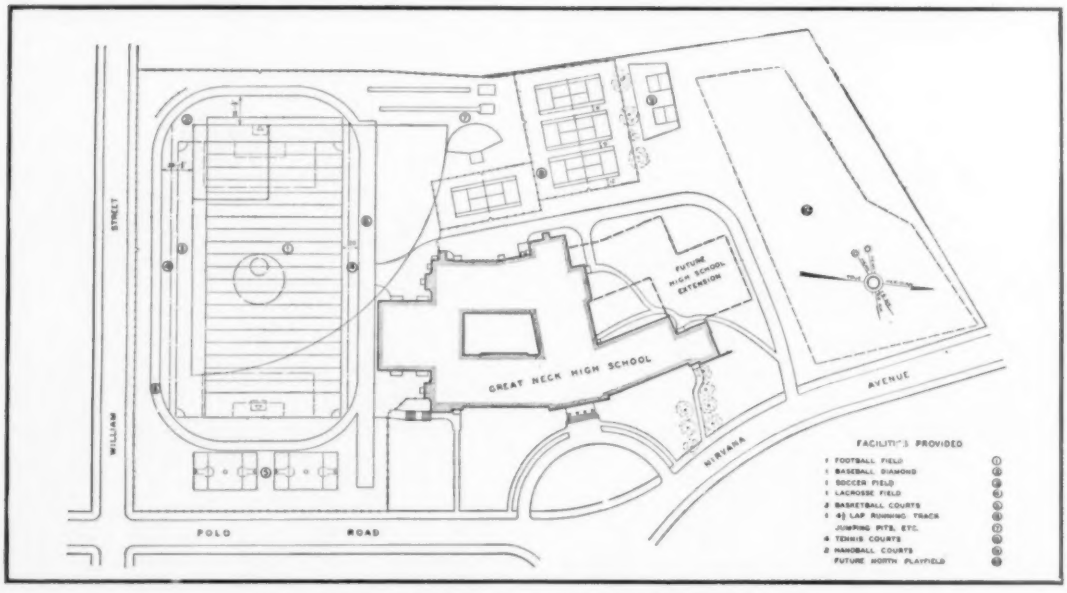
HIGH SCHOOL ATHLETIC FIELD AT ISLIP, N. Y.

tracks, nor full 220 yds. straightaways, but these standards are very desirable.

5. The units listed for footfall, baseball, field hockey, etc. (Col. 3), are separate units which may be used simultaneously, but each unit may be used at separate times for different games. For example, the same field may be used in the fall for football and in the spring for baseball; or the same field may be used during one hour for football and during another hour for field hockey.

6. In the tennis court figures (Col. 4), "D" designates doubles courts and "S" designates singles courts. The average proportion of doubles and singles games has been assumed as indicated in the list, but in the usual case it is best, if possible, to construct all courts for doubles, allowing them to be used for singles also if desired.

7. The number of lockers given (Col. 7) is the number of temporarily assigned athletic lockers only, and it is assumed that a double locker system will be used, with a permanently assigned school locker for each pupil. Proportional shower, toweling and toilet facilities (and dressing cubicles for girls) should be included in the locker suites. Separate rooms for visiting and home teams are desirable, especially for visiting teams. Where the outdoor athletic facilities are located close to the indoor facilities, the same lockers should

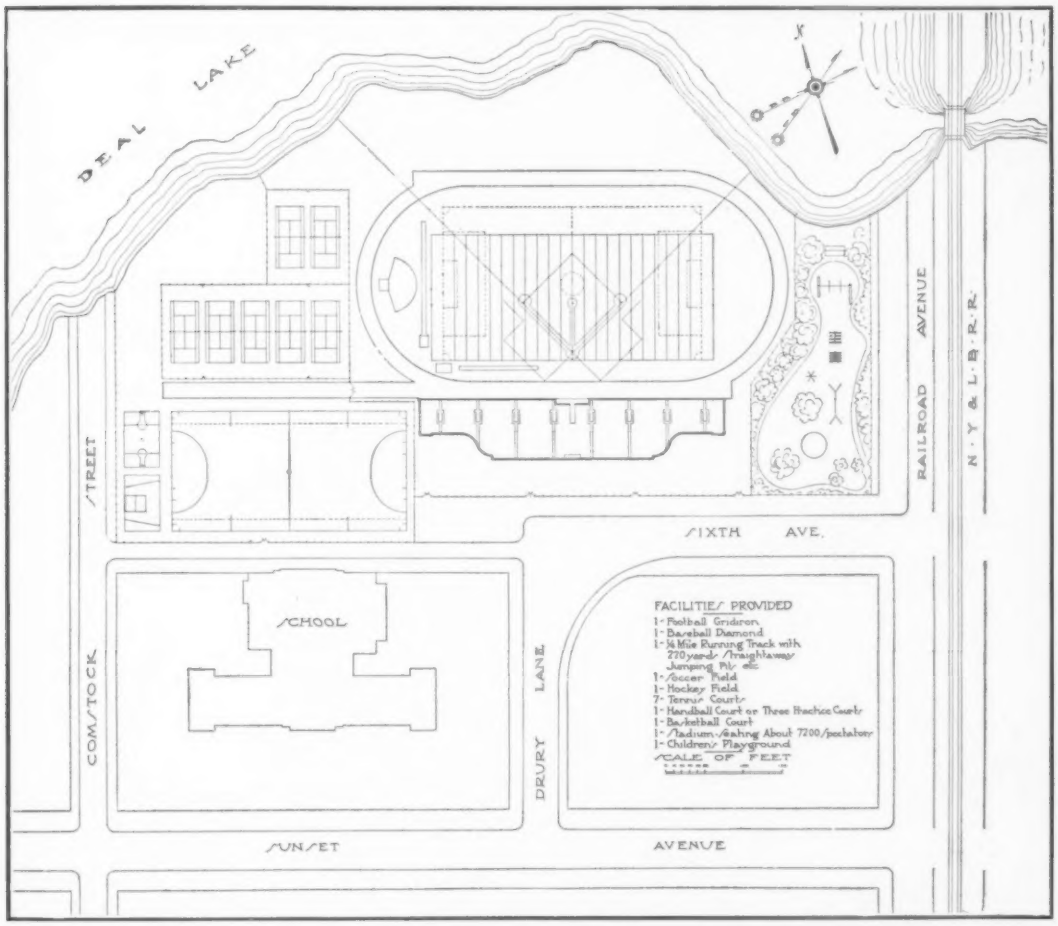


PLAYFIELDS AT THE HIGH SCHOOL, GREAT NECK, N. Y.

be used for both, but if the two classes of facilities are separated by a considerable distance, a duplication of lockers becomes very useful if not absolutely necessary. A greater number of lockers than those listed is very desirable but not necessary.

8. No allowance has been made in preparing this list for pupils who may obtain outdoor exercise from hiking, cross-country running, rowing, canoeing, swimming, riding, etc., as it is believed that the average school cannot count daily on any appreciable percentage of its pupils following these activities; where conditions permit, however, such activities must be considered and suitable revisions should be made. Nor has any reduction in facilities been made on account of pupils taking part in winter sports such as skating, hockey, skiing, coasting, etc.; these activities are properly substitutes for indoor athletics rather than outdoor athletics, and even where the climate permits them with any degree of regularity, they can rarely be counted on as continuous daily activities. These winter sports are, however, extremely beneficial and are encouraged wherever possible. Some of the regular outdoor facilities included in the list can in the usual case be suitably adapted to use for winter sports, when natural conditions permit.

While the list as given is intended as a guide for high schools, it can be used, with proper modifications and revisions, for private preparatory schools also. These latter schools, particularly the boarding and country day schools, have usually sufficient open land available to enable them to provide without serious difficulty more than the minimum facilities recommended. These schools are perhaps more often deficient in indoor facilities than in outdoor facilities.



ATHLETIC FACILITIES PROVIDED FOR HIGH SCHOOL AT ASBURY PARK, N. J.

The illustrations herewith show in plan athletic fields for three different high schools, at Islip, N. Y., at Great Neck, N. Y., and at Asbury Park, N. J. It may be noted that in each of these developments the number of facilities provided has been restricted by the boundaries of the school properties. They are of interest, however, in showing how the arrangement of the facilities may

be made to fit properties of various shapes and dimensions.

Athletic Facilities for Universities and Colleges

For universities and colleges the problem of determining what facilities to provide becomes more difficult, and for the larger institutions it is impossible to provide enough facilities to permit all those who need them to have the opportunity to take part in the various activities. The larger universities are for the most part located in larger communities, where open land is scarce and valuable, and the physical restrictions therefore influence the problem very materially. Nevertheless, the same general method may be used to arrive at reasonable recommendations for these institutions, calculating the number of students who should have daily facilities and apportioning them by reasonable assumptions to the various activities. Many university students, particularly those in graduate schools, are disinclined to take part in team games, and for these the so-called individual games and exercises, both outdoor and indoor, such as tennis, golf, handball, single-sculling, squash, racquets, etc., are most popular and most useful. Graduate students, furthermore, are more apt to have odd hours available for their exercise and recreation, and for such students the difficulty of scheduling practice sessions or games for whole teams simultaneously tends still further to limit their activities to those requiring but two or at most four participants.

A general list such as that prepared for high schools would have such a limited application as to be nearly valueless, but the results of one specific study, with all assumptions and given conditions on which it is based, will serve as an example and guide.

STUDY FOR UNIVERSITY OUTDOOR ATHLETIC FACILITIES

Conditions and Assumptions

University Enrollment:

Undergraduates, men:	1,500	Graduate students and Faculty, men:	1,000
women:	0	women:	100

Physical Conditions:

All University buildings and grounds located within convenient walking distance
Ample land available
Water for rowing available
Golf courses available nearby (either public or private or both)
Climate, temperate with long seasons in fall and spring available for outdoor athletics

Desired Games:

For undergraduates:
- Football
- Rowing
- Baseball
- Track and field
- Soccer
- Lacrosse
- Tennis
- Golf (on neighboring private and public golf courses)
- Outdoor handball

For graduate students:
- Tennis
- Rowing (mostly in single sculls and pairs)
- Running
- Baseball (occasional)
- Golf (on neighboring private and public golf courses)
- Outdoor handball

RECOMMENDED MINIMUM OUTDOOR ATHLETIC FACILITIES

For Fall Use:

Football gridirons:	4	Boating facilities shells, seats:	200
Soccer fields:	1	Tennis courts:	9 doubles
Running-tracks:	1		20 singles
¼-mile with 220 yd. st. and jumping-pits, etc.		Outdoor handball courts:	12

For Spring Use:

Baseball diamonds:	5	Boating facilities shells, seats:	200
Lacrosse fields:	1	Tennis courts:	9 doubles
Running-tracks:	1		20 singles
¼-mile with 220 yds. st. and jumping-pits, etc.		Outdoor handball courts:	12

These facilities include those generally regarded as most desirable and most beneficial. They would provide a reasonable capacity for the students in such a university who might be expected to use them. With all facilities located close together, in accordance with the physical conditions laid down, their flexibility and efficiency in use would be high. In cases where, as sometimes happens, various departments of the university, graduate or undergraduate, are separated by considerable distances, it becomes necessary to divide the facilities between two or more locations. This of course reduces the flexibility of use and may require some increase or duplication of facilities for athletics.

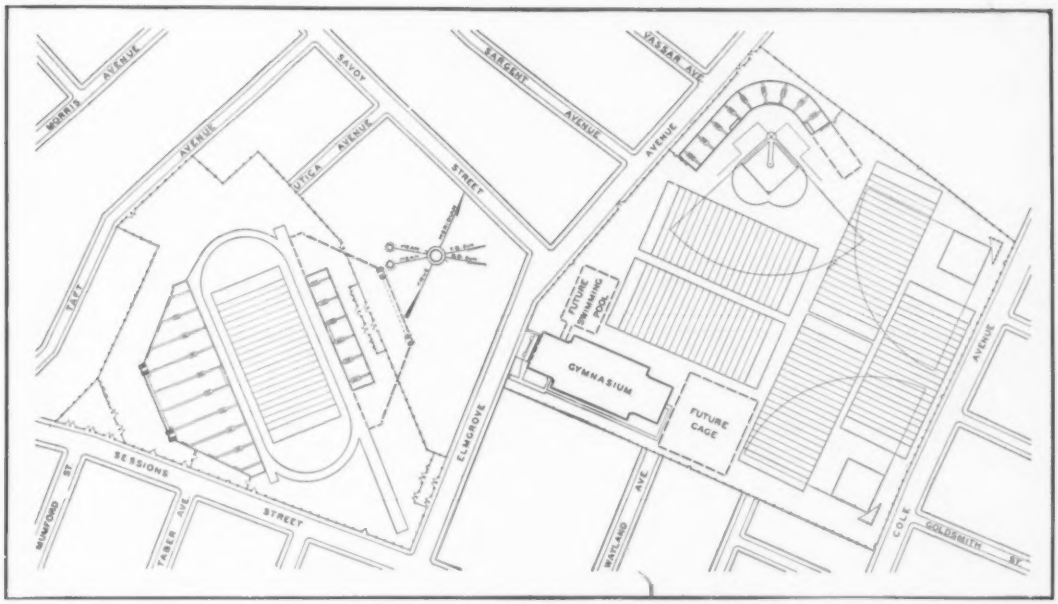
With facilities such as those recommended, there would be a total playing capacity of about 2,000 players per day in the fall and about 2,300 players per day in the spring, and the ground area required would probably be from 25 to 35 acres, dependent principally upon the topography of the ground, the possibility of securing an economical design, and the demand for seating of spectators.

The illustrations herewith show in plan athletic fields for two different universities, Cornell University, in Ithaca, N. Y., and Brown University, in Providence, R. I.

Alumni Field, at Cornell (shown in duplicate to distinguish the facilities to be used in the spring from those to be used in the fall) is only a part of the total area devoted to athletics. A total area of about 60 acres is available for outdoor athletic facilities of all kinds at this university, which has a total enrollment of nearly 5,000 men students. When it is considered that the average facilities required per 1,000 students decreases as the enrollment increases, it is evident that this university is well equipped in this respect.

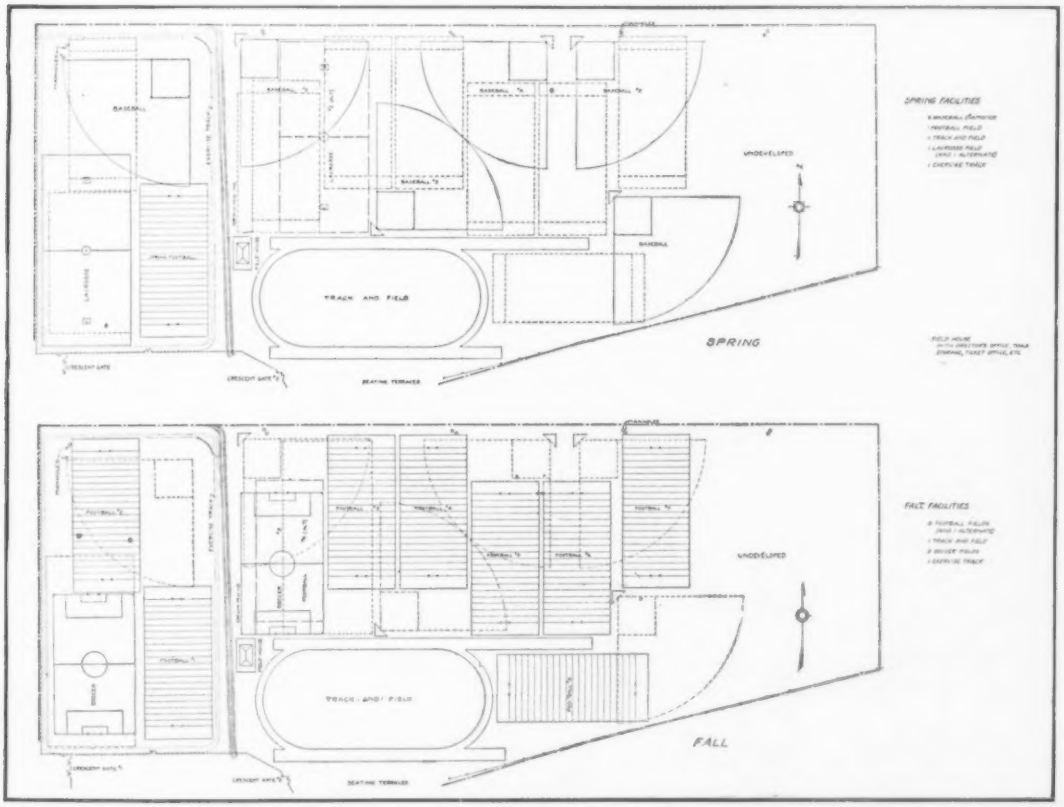
The Brown University Athletic Fields here shown are likewise only part of the total area devoted to athletics at this university. The development shown is located at some distance from the campus, because of scarcity of land near the university buildings; and other fields, tennis courts, etc., near the campus bring the total acreage for athletics to about 32 acres, although all of this is not completely developed. With its present enrollment of 1,543 men students, this university is therefore also well equipped.

In designing facilities for mental education, the attempt is always made to provide the facilities

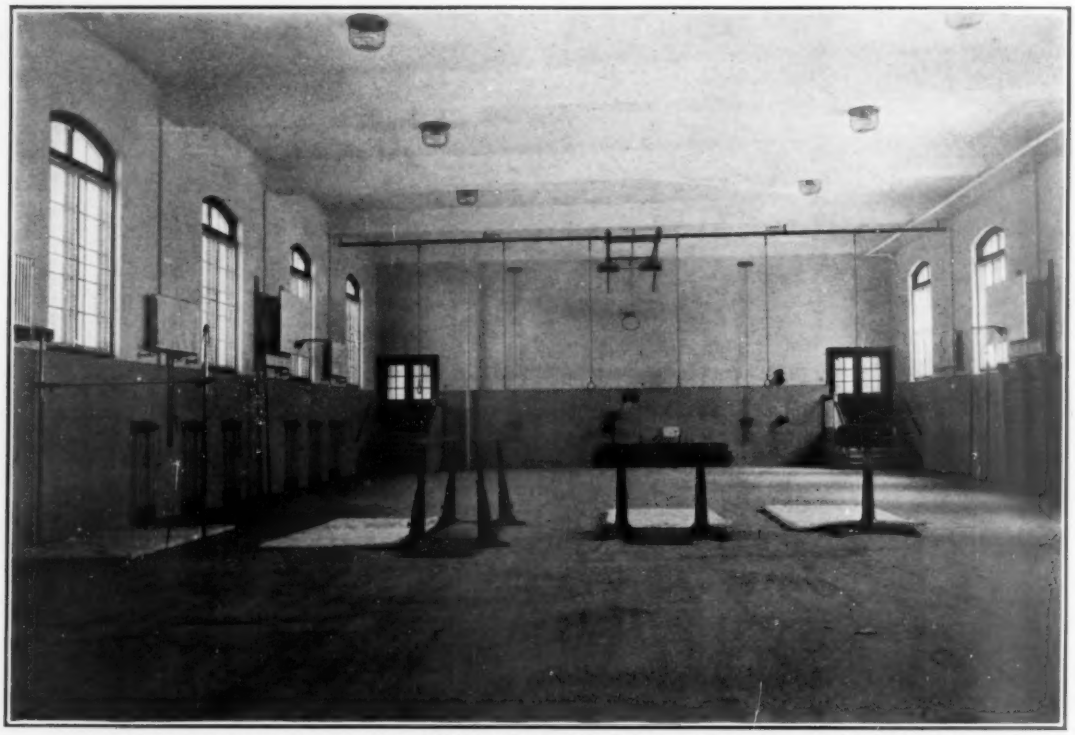


BROWN UNIVERSITY ATHLETIC FIELDS, PROVIDENCE, R. I.

required to meet the desired capacity. The same policy should be followed in designing facilities for physical education and recreation, and this discussion can perhaps serve as a guide and help to those in charge in determining the outdoor requirements for specific cases.



PLAN FOR FUTURE DEVELOPMENT OF ALUMNI FIELD, CORNELL UNIVERSITY, ITHACA, N. Y.



GYMNASIUM OF ST. CHARLES BORROMEO THEOLOGICAL SEMINARY, OVERBROOK, PA.

Harry Barton, Greensboro, N. C., Architect

HIGH SCHOOL GYMNASIUM, HIGH POINT, N. C.

Gymnasiums, Lockers, and Swimming Pools

BY LOUIS JALLADE
ARCHITECT, NEW YORK

THE general theory underlying the planning of physical education facilities is the same for large or small institutions—in other words, what applies in the planning of the university gymnasium applies likewise in the planning of the grammar school gymnasium.

The fundamentals or theories that underly the planning of these facilities are few and very simple, based a good deal on common sense, but the details that enter into the construction of these buildings and rooms cannot be readily understood or appreciated unless one has lived through the planning and building of many of them. It is these details that make a physical education building, gymnasium or swimming pool a success or a failure. In order to understand the purpose of this article it will be necessary for the reader to read with the physical director's point of view rather than with an architectural point of view.

Furthermore, in reading this article, one must remember that a building or equipment for the purpose of carrying on physical education is only a means to an end: it is a vehicle in which this educational program may be carried and it must change and adapt itself to the constantly changing program of physical education. If we review the progress of the last fifty years, we shall find that the old gymnasiums were small halls where ceiling height was unnecessary except as required for the swinging of trapeze or rings or rope climbing; basket-ball and indoor baseball were then unknown. Running in the gymnasium had not yet been started, and spectators' space, while provided, was very small because most of the work consisted of heavy apparatus exercise. Games were not played and spectators were very few. It was quite all right then to have columns or support piers running through the gymnasium, and these obstructions were not objected to until the group games came into use.

With the advent of basket-ball, it was necessary not only to eliminate the columns but to provide a higher ceiling and spectators' space, and the entry of this game did probably more to change the general character of the gymnasium than any building factor in the world.

There has been another development in gymnasium planning, which has not yet crystallized —that is, the tendency towards a number of small gymnasium units rather than one big unit—these small units being so planned that they can be thrown into one large unit when desired.

As to the future development, little can be predicted; but in the northern states where outdoor fields cannot be used in severe weather the so-called "indoor field" must be used—as in the case of Hamilton College—and these indoor fields may have a tendency to materially change the purpose and design of the standard gymnasium.

Ideals of Gymnasium Planning

Size.—In considering the fundamentals of planning for a gymnasium, we have, first, the size. The two games played in a gymnasium which require the most space are indoor baseball and basket-ball. Indoor baseball is best played in very large gymnasiums or armories, but the floor space for basket-ball can be suited to the conditions. It is inconvenient to play on a surface less than 45 x 60 feet, with a height of 15 feet. While this is the minimum, I know of a great many gymnasiums much smaller. They are really exercise rooms and not gymnasiums. It would be well to bear in mind in planning that, for the purpose of team practice, the size and condition should be such as will be met in other gymnasiums. It is rather bad to have a school team practice in a small gymnasium, dodging around obstructions, and then have it play against another team in an open, clear, luxurious space.

I have found that for colleges, an approximate size for freshmen and sophomores is about 60 x 80 feet, and for the upper classes 80 x 125 feet, while a gymnasium for the faculty and for special exercises is amply large at 40 x 60 feet.

For smaller colleges, the sizes are not reduced, but the number of gymnasiums may be reduced.

For schools, the program and the possibility of development, depending upon the size of the lot, must be considered before recommendations are made. I may say that it is better to have two gymnasiums 60 x 80 feet, rather than one 80 x 120, and it might be better still to have one 40 x 60 and another one connected to this one, say about 70 x 90. In other words, it is better to have two gymnasiums of different size that can be connected, than it is to have one immense gymnasium.

Shape.—One will understand that the wider you make the gymnasium, the heavier the trusses or girders will have to be—that is, a 60-foot-wide gymnasium is cheaper to construct than a 70-foot gymnasium. But a gymnasium should never be less than 45 feet wide. Gymnasiums that have had an oval shape or a circular shape or the shape of a diamond have not been successful. The ideal shape is rectangular.

Height.—The height depends on the length and width of the gymnasium. For practical playing purposes and for architectural appearance, the bigger the gymnasium the higher it should be, for proper proportion, but the ceiling height should

never be less than 20 feet to the bottom of the beams. Again, this ceiling height has something to do with the spectators' galleries. There should be a clear distance of 12 feet from the floor to the underside of the gallery. The gallery takes about a foot in thickness, and the spectators should have at least 7 feet headroom, which gives a height of 20 feet.

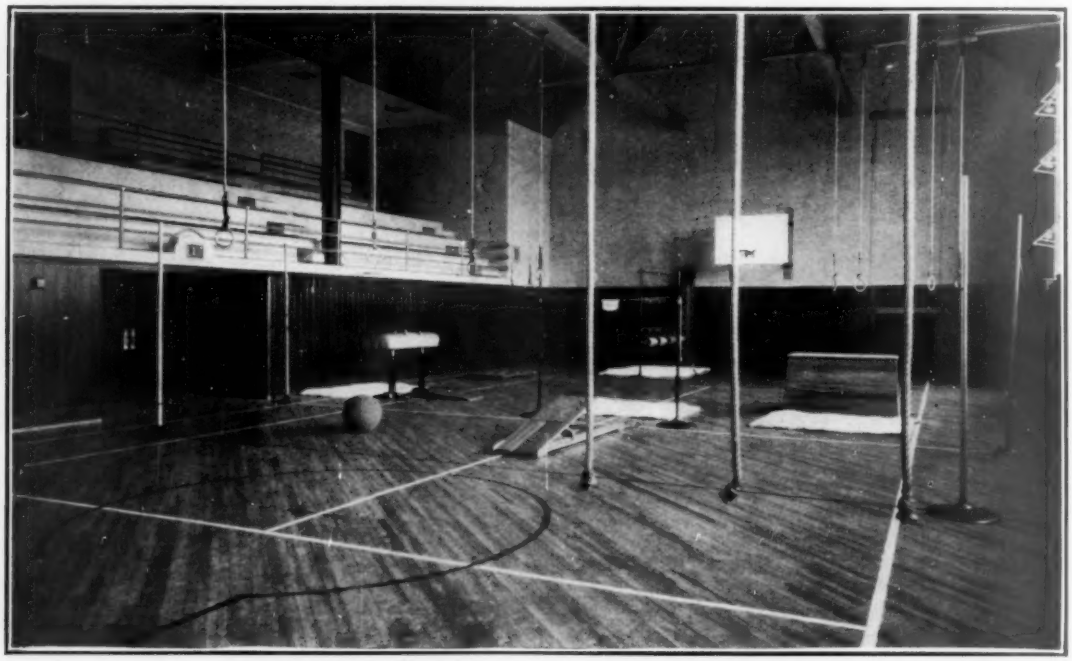
Freedom from Obstruction.—Next in importance to size, we might place freedom from obstruction, but it is strange how people differ in their ideas of an obstruction. Some think that a radiator projecting in the room down near the floor level is not an obstruction, and others believe that steam or plumbing pipes running along the walls are not obstructions. I say emphatically, that the ideal gymnasium is one in which there is no pipe, radiator or projection from the wall of any kind. If radiators are used, they have to be placed under the windows; in that case, so as not to project into the room, they should be recessed in the walls. If there is a system of artificial ventilation installed, then, of course, vent apparatus must be flush with the wall.

Stairways.—Another troublesome matter in the planning of the gymnasium is that of stairways to the galleries and to the locker rooms. All stairs should be outside of the gymnasium hallways to make for a clear floor space, and no stairs should open into the gymnasium but should have an offset so that men running out of the gymnasium must make a turn before going down; this will prevent serious accidents. Circular stairs are no longer used. Stairs to locker rooms should be vestibuled on account of difference in temperature of gymnasium (60°) and locker room (70°).

Supervision.—The whole of the gymnasium and the stairways, exits, etc., should be under the direct view of the gymnasium attendant, whether he be clerk or physical director. It is imperative that a director should have his office so placed that he may see his men working on the floor. This may not be advisable for institutions where a large staff is employed, but it is certainly true for the smaller gymnasiums.

Spectators' Sightline.—Probably the most difficult problem I have when acting as consulting architect is to make building committees realize that spectators' galleries when up in the air—say, over 10 feet—do not allow (except for the front row) of a proper vision of the playing floor space. Running-tracks when used as galleries make the best spectators' galleries, provided they are not too wide. The ideal gallery is one around the gymnasium, 4 feet wide, so that there is one man sitting and one man standing. There is one other method which is of course still better, and that is, bleachers which start level with the floor.

Gymnasiums Used for Other Purposes.—The gymnasium may at times be used as a general utility room, that is, as an auditorium. Some gymnasiums are built with a stage at one end, or may be used for the purpose of giving banquets or affairs or shows, at which time it is necessary to have extra seating or tables. Provision must be made for the storing of these chairs and tables, bearing in mind that the chairs are stacked one over the other on small trucks, and the chairs remain in that position in the storage room until required again. Chair and table storage should never be under the platform of the stage,—it has never been found to work well,—but the storage



SHOWING THE RESTRICTED SIGHT LINE OF A SIDE GALLERY

COMBINATION AUDITORIUM-GYMNASIUM, FARGO, N. DAK.
Gymnasium serves as stage for auditorium.

should be in a separate room in which the walls are made of brick or some other indestructible material.

If the gymnasium is to be used for banquet purposes, then there should be provided a serving room. If there is a stage, then dressing-rooms must be provided. Sometimes two gymnasiums are used—one opening into the other, but one gymnasium at a higher level, so that it becomes the stage, and the other gymnasium at the lower level, which becomes the auditorium.

There is another matter to carry in mind and that is "circulation"—the path used by people going to and from the gymnasium to the locker room, bearing in mind that the ideal would be one where all corridors between these two rooms would be eliminated. There is another circulation which is from the street to the spectators' galleries—bearing in mind that the ideal is one wherein *no one passes* over the gymnasium floor unless he is in rubber-soled shoes.

There are a great number of small items that enter into the planning and construction of a gymnasium which cannot be touched on in this article. Among such items I would say are the recessed cuspidors and drinking fountains such as the author devised for the Y. M. C. A. and which have since become of general use, the wall rail for fastening apparatus, the iron angle wall base and hardware, etc. We will not enlarge on these, but call attention to the necessity of study when these items are reached in planning.

Light, Heat and Ventilation.—It would seem that the ideal lighting of a gymnasium would be through skylights, but this is not true. Skylights give a certain amount of leakage due to the constant changes of temperature to which they are subjected. Then there is the admission of too much sun into the room at the time that additional heat is not required; also in the early mornings and afternoons of winter there is a serious dropping of cold air from the skylight; in other words, the warm air rises and when it strikes the skylight it chills and then drops into the center of the room, from which point the circulation back to the radiators is extremely slow. The skylight is of very little value in ventilating the gymnasium.

The ideal light and ventilation is through the side windows, and the designer should attempt to bring his windows down to the floor. While this is a new idea that I am trying to develop, it is not practical in every case; in other words, it is often difficult to bring the windows below 6 feet. But

the ideal ventilation in the summer time is directly across the gymnasium from side to side, and the air should be ventilated or removed at about 4 feet above the floor. Therefore, all gymnasiums should have low-down windows on both sides, so as to produce this draft.

One of the difficulties found in gymnasiums is that of opening and closing windows. When it rains, the windows must be shut; or when it turns suddenly cold, they must be closed. It is therefore a rather tedious operation to go around and open and shut windows—the windows are covered with a wire screen, the screen has to be opened and then the windows opened or shut, and the screen shut. This is too much work for some janitors and so windows are left open on cold nights or snowy days.

To overcome this janitor-inertia condition, the writer has devised a window somewhat on the system of a window shutter whereby all the windows on one side of the room are operated by the turning of a handle. This device is not patented. This method of window lighting and ventilation is recommended because it is easy in operation, does not let in the rain, and the windows can be operated by one turn of a wheel without moving the screen.

As to heat—Dr. McCurdy at Springfield College demonstrated some years ago how it was possible to conserve the heated air in a gymnasium by taking it through a washer and bringing it back into the room without waste of fuel. Bear in mind that if you bring cold air into the gymnasium and heat it to 65° and then thrown that air out, you are wasting a great amount of fuel. Therefore, Dr. McCurdy's system should be seriously recommended.

GYMNASIUM BASKET STORAGE ROOM, SENIOR HIGH SCHOOL, PAWTUCKET, R. I., SHOWING THE ARRANGEMENT FOR BASKETS OF THE TOTE-BOX SYSTEM

In a small gymnasium this may not be necessary. There should be enough ordinary radiation so that the room never becomes thoroughly chilled during the night. Then by a system of fans at the radiators themselves (and there are several patented devices on the market) the heating can be brought in from the outside directly over the radiators and sufficient clean air supplied into the gymnasium. The small gymnasium need not be ventilated for general exercise purpose. The large gymnasium should have a certain amount of ventilation. Each problem should be treated by itself.

Materials for Interior Surfaces

Floors.—Wood floor should never be laid directly on the ground if there is no cellar underneath. Finished flooring should be set up on sleepers on top of an underfloor. There should be a soft felt between the underfloor and the finished floor. The upper floor surfaces should be maple. There are some rooms—locker rooms especially—that should have cork floors, if funds permit. In special exercise rooms, I should like to use wooden blocks on ends. In certain rooms, I should like to use rubber flooring, but for a main gymnasium floor I have found nothing better than hard maple.

Walls.—These should be of an indestructible material—by that I mean, anything but plaster. It may be brick—either face brick or common brick. It may be stucco finish of cement. But here again it is a question of usage. If the gymnasium is to be used for an auditorium, then the walls should be of a soft brick so as to absorb the sound, or, as in the case of my last two gymnasiums—the entire walls from floor to ceiling may be covered with oak flooring, on the basis that anything that you can walk on makes a good wall surface. The acoustics of these two gymnasiums are perfect. If the gymnasium is not to be used for entertainment purposes, then you can use a vitrified brick that can be washed. I do not recommend stucco unless it is absolutely smooth. The surface should be such that it is not like sandpaper—ready to take off a man's skin—and it should not have loose particles, as, in common brick, constantly falling and eventually ruining the floors.

Ceilings.—If very high, ceilings may be plastered. This is sometimes desirable for acoustical purposes. It might be possible to leave the concrete slab exposed or painted, or one might use a wooden ceiling. The ceiling is not important, except that it should reflect light and absorb sound.

AN IDEAL ARRANGEMENT FOR LOCKERS AND THE USE OF CORRIDOR SPACE, IN THE SENIOR HIGH SCHOOL, PAWTUCKET, R. I.

Exterior Walls

In the early summer and the late fall—when there is a decided change of temperature on the outside—it is a common thing to get condensation on the walls. This applies not only to gymnasiums but particularly to swimming pools; and so it is advisable that, whenever a gymnasium or swimming pool has its side walls or roof exposed to the air, the walls should be built with a hollow space, and the roof be covered with asbestos, cork or felt blocks, air spaces not being sufficient.

Waterproofing of Walls and Floors

It is sometimes customary—because of architectural reasons—to partly submerge a gymnasium in the ground. This is often done through ignorance; the chief objection is the need of circulation of air down to within 4 or 5 feet of the floor, which does not naturally occur when this room is submerged. There is the question of waterproofing, which becomes serious. Particularly if the building is on the side of a hill, waterproofing must be used; otherwise the floor will rot, and I might say that the floor is the most expensive part of the gymnasium. Because of the vast surface of the gymnasium and the difficulty in obtaining weight to hold down the waterproofing, it is imperative that the gymnasium be placed above water-level, especially in a tide-water country.

Repairs and Janitor Service

As to general cleaning, washing and janitor service, the rules that apply to other types of buildings also apply here; that is, that "all buildings deteriorate rapidly unless constantly kept in repair"—tuned up, as it were. There is, of course, a type of building with which no one will ever get abreast, in the matter of repairs—one that was badly started. One can readily understand that if poor materials have been used—steel pipe, for instance—or plaster in showers—or pipes passing through shower room floors—or marble stalls around the showers—or a thousand and one things that I might mention—not only will you not be able to keep the building clean, but you will not be able to keep it in repair. It is necessary, therefore, to start off with a wise selection of materials.

Next to repairs comes the question of janitor service, its efficiency and cost. As indicating the importance of considering the question of time consumed in cleaning, it is easy to understand that a series of wash-basins supported on one or two porcelain legs each, requires much more time for sweeping and mopping than a series of basins supported on brackets and having no legs.

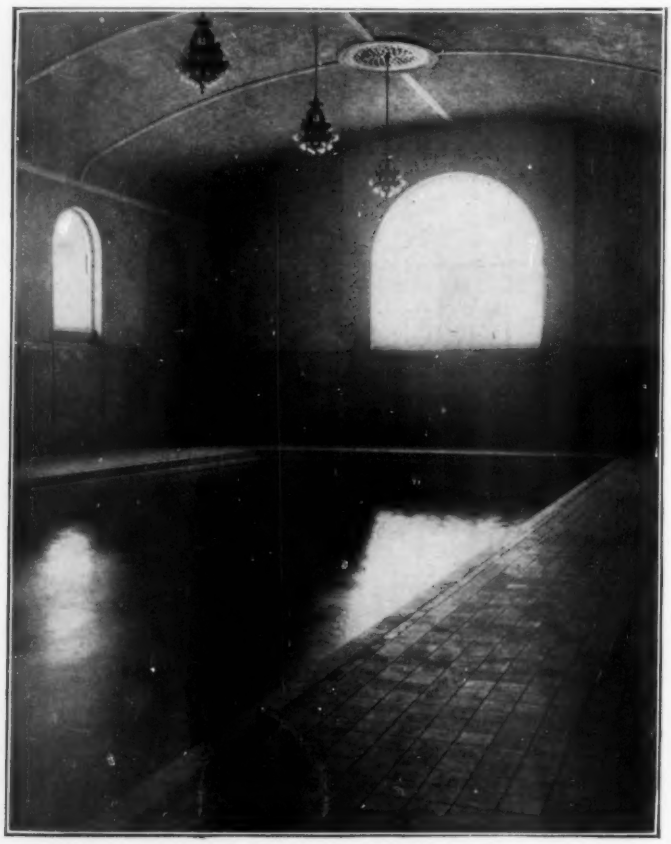
Locker Rooms

The design of the locker room will always be a matter of controversy. There are, nevertheless, some fixed principles that must be observed. First, there is light, and for the purpose of economy the rows of lockers should be perpendicular to the wall, so that the lights illuminate the aisles. Second, the ceiling must be high enough so that the artificial illumination, which should be close to the ceiling, can shine over the

whole room rather than through the aisles. Third, it should be possible to shut off the room so as not to have any drafts or current of air to deposit dust on the clothes. Fourth, the room should be so arranged that the lockers can be super-heated at night, so that the clothes that are left in them are dried the next morning.

The ideal arrangement is one in which the floor is built up under and to the edge of the locker, where there is a steam pipe under the locker, and where ventilation is through the locker from the bottom up. At night or on a rainy day, the steam can be turned on and the lockers kept warm to dry wet clothes, and in order to take out the bad or wet air; then the entire room is ventilated or each stack of lockers is ventilated. There are one or two things to observe in the placing of a locker room. It should never be below the gymnasium, unless it has a vestibule between the gymnasium and itself, because the cold air in the gymnasium drops into the locker room. There is the matter of materials—the best floor is cork, then tile, next, cement covered. The walls are best when made of brick. The ceiling should be plastered whenever possible and painted white.

Now as to the lockers. There is the individual locker, one or two tiers high. As the two-tier locker does not allow the occupants of each locker to dress at the same time, such lockers are applicable only when the users rotate in the use of the room. Then there is the individual locker which is used all the time by the same person or the individual locker which is used part of the time in connection with a tote box. In other words, the user goes to a smaller locker and takes out a basket (or tote box) and then uses one of the bigger lockers, or he goes to the attendant and gets his basket and uses one of the bigger lockers. We will not go into the merit of these schemes, but will say that if the tote box is used—either with the attendant or with the smaller locker—then it is necessary after use to take out the contents of the baskets and dry them (being in a small basket they can not dry themselves), clean and return them. That entails space for the attendant to bring in his trucks containing these baskets to put them in the laundry room and then in the dryer and put them back on his truck and bring them back to their places. This means considerable space in the planning.



THE DARTMOUTH COLLEGE POOL

This is a pool of architectural merit, well designed, and of lasting materials, in which one is surrounded with the feeling of comfort and dignity. Designing a pool with such materials does not increase the cost very much.

Showers

Showers for men and showers for women, when used in connection with the swimming pool, must be placed so that they are between the locker room and the pool; in other words, one should leave the clean shower room and with one step be into the water of the pool. Long walks allow the bather to pick up dust and dirt on his feet, and it is that which makes the sediment on the bottom of the pool and brings on trouble.

The writer has tried for a great number of refinements in the shower technique, and we can give here a few. There should be no pipes in the shower room. It is important to keep them out on account of their dripping and rusting. The floor should be of a basket-weave tile to prevent slipping. The drainage of the floor should be towards the wall. The shower heads should be offset from the valves. The soap dish should be below the shower heads, so that it is constantly being washed out, thereby eliminating soap stains. Large-size tile should never be used, because of the possibility of voids behind. Marble on three sides should never be used, because you can never get a tight joint; use marble and ceramic. The radiators should be brass. There should be no pipes going

ILLUSTRATING FAULTY DESIGN IN A SWIMMING POOL

Note the short distance at the spring board. There should be at least 9 feet running space.

Note the spectators' gallery at the hottest part of the room, and the difficulty that the second row of spectators encounter in viewing the games.

Note the location of the lighting fixtures, which cannot be reached without a scaffold.

Note the projecting ladder in the pool, a method obsolete years ago.

The windows behind the spring board do not help the diving.

A GOOD EXAMPLE OF WHAT NOT TO DO IN BUILDING A SWIMMING POOL

Note the various obstructions and corners and holes, and the lack of space along one side of the pool for swimming demonstration for classes.

Note also the plumbing pipes in the ceiling, which might have been hidden, and at the right the shower heads within the swimming pool room.

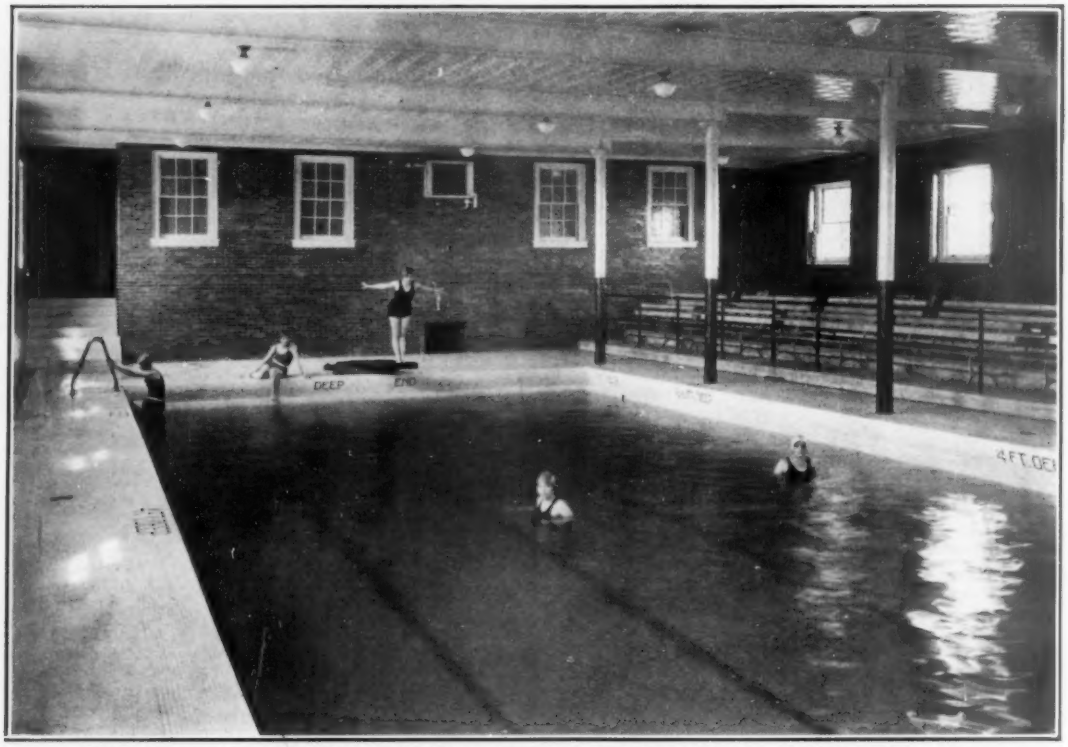
A new pool built on the standards of 25 years ago.

through the floor. All, if any, pipes in this room should be brass. The window frames and sash should be copper covered. The doors on bith sides leading to the shower room should be copper covered and the hardware bronze. This applies to men's and women's rooms. There are many other matters to be considered, but the space does not allow. We will say in the passing, however, that the temperature regulation for the water, the use of solitary cold shower head, drying space, etc., are matters that require a great deal of consideration.

Swimming Pools

The growth of the swimming pool in public schools and the physical education buildings has been phenomenal. There have been more swimming pools built than gymnasiums—counting in this, of course, the private pools.

The building of a natatorium or a pool is not a particularly complicated matter. There is, first, to be built a concrete box reinforced. This box is covered with tile and, of course, if the box is tight so is the tile. The next thing is to know enough to keep your spectators down at the level with the water. Up to 1916, the writer was doing what everybody else was doing and that was putting the spectators up in the gallery where it is 120° with winter clothes. Since then he puts his spectators down on the ground floor—it is more comfortable. The next thing to consider is that the room must be so arranged that the spectators never walk on the same surface as the bathers.



POOL IN THE WALTER REID BUILDING, STATE TEACHERS COLLEGE, HARRISONBURG, VA.

The expenditure of a little more money in dressing it up would have made this pool architecturally beautiful, but it has all the features necessary for a successful and practical pool.

Next is to use sound-absorbing materials in the ceiling, because this room is nothing but a big bathroom and echoes terribly. The next thing is to get a perfect system of water circulation, filtration and sterilization so that the heating and purity of the water are conserved. Next, but not least, to make the swimming pool look like a place of joy rather than a big, overgrown, terrible-looking operating room.

Wood should not be used in this room except in the springboard. Iron should never be used, because it stains. The materials to use are bronze, copper, brass and white metal.

One other thing to remember is that the ventilation and heating of this room are rather important. The room must be kept at about 80° in winter. This is done by having a large number of radiators which must be out of the way—concealed if possible. There is no use of throwing all the air out in the street; most of it might just as well be circulated over and over again. Ventilation is largely a question of keeping the air moving.

Acknowledgment.—Illustrations for this article furnished by courtesy of Fred Medart Mfg. Co., Narragansett Machine Co., Norwood Engineering Co., A. G. Spalding & Bros. and Wallace & Tiernan Co., Inc.

Schools and School Play Yards—A Scientific Method of Determining Their Location and Urgency

BY GEORGE B. FORD

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IN a growing city, one of the most important functions of the board of education and one needing constant planning is the expansion of school accommodations to provide for the increasing enrollment. The average annual increase in enrollment is from 12 to 25 per cent of the population increase. One new class room will be needed for each 40 to 25 new pupils. In addition, old school buildings wear out or become obsolete and have to be replaced. Just what to do in any given case is difficult to decide unless the problem is studied scientifically.

Obviously, from the standpoint of school requirements, both educational and administrative, the board of education is better qualified to select school sites, to delineate school districts, and to determine the dates when new school facilities should be provided than is any other body. It cannot be denied, however, that even with the utmost care and thought, it has been extremely difficult to avoid mistakes in the selection of school sites, on account of the limited information hitherto available concerning the probable future development of the city. There may be found schools in almost every city that are gradually being engulfed by industry or business; school sites at the intersection of streets that have lately developed into heavily traveled thoroughfares. The board of education, as well as the general public, is extremely anxious to obviate the recurrence of these conditions and to have a reasonable assurance that new school locations will be such as always to remain in accord with future city development.

How the City Planning Commission Can Help

The city planning commission should have gathered together a new mass of facts affecting the city's growth. It should be in a position to help base a school expansion program on a sound and rather exhaustive foundation of fact. The commission's population growth and population distribution studies, the zoning plan, the plans for thoroughfares, parkways, parks and playfields and for transportation and transit facilities, offer a basis for prognostication surpassing by far anything heretofore available. With all this information at hand, the planning commission can be of invaluable service to the community in general and to the board of education in particular. Boards of education in many instances have already recognized the value of the data gathered and the studies conducted by planning commissions and also of the need of cooperation between the two bodies.

On the other hand, from the planning commission's standpoint there are reasons why it should make its own comprehensive study of the school expansion program. It is one of the functions usually assigned to planning commissions to approve the location of public buildings. These necessarily include schools. It is also important from the standpoint of the city plan that the location and size of schools and their plots should be correlated with various other features of the plan, such as the location and size of playgrounds, parks, parkways, thoroughfares, transit and transportation facilities and other public buildings. A school can often be combined to good advantage with a park or playground. It should not be located on what may well become a main traffic highway. It should be near transit facilities. It can often be grouped effectively with other existing or proposed public buildings. Again, the necessarily limited income of any given city forces a balancing of school with other improvement projects in working out a practicable long-term capital budget.

On the other hand, the planning commission can know little of the problems of school administration and of educational policy. Therefore, in approaching the problem of choosing sites for schools it must first learn what policies with regard to these matters the school board desires to maintain and use these as a point of departure in all of its school studies. The planning commission must also make certain assumptions with regard to the execution of the rest of the city plan. Thus, a study of schools and school play yards may well assume the following:

Assumptions

1. That the zoning plan will be put into effect and also that the city plan will be carried out at least in its major features.
2. That the population growth and the population distribution studies upon which the estimates for future enrollment are based are reasonably accurate.
3. That there will be no considerable reduction in the size of families.
4. That there will be no radical change in the

public school attendance tendencies, that is, that the proportion of the various age groups attending public schools at present will remain about the same; this also includes the assumption that about the same proportion of the school-age population will attend parochial and private schools as at present.

5. That the present boundaries of school districts do not necessarily have to be maintained.

6. That the school system will develop eventually, if not already, on the "6-3-3" basis; that is, with a junior high school program for the seventh, eighth and ninth grades.

The traditional plan would normally be assumed in calculating the number of permanent seats needed, that is, a separate seat for each pupil. This would simplify the preparation of the program as well as aid its future use. In case the platoon system is in use, the recommended school-building program could easily be adjusted by reducing the number of seats needed at any given time to correspond with the 25 to 40 per cent increase in the capacity of schools under the platoon system. Obviously, this would also mean more liberal play space per pupil; quite an important consideration in the case of some schools in densely developed areas, where the acquisition of additional playground space would be likely to prove expensive.

Method of Study

The method usually followed by a planning commission in the preparation of a school expansion program is necessarily based on a study of existing conditions. For this purpose the following data with reference to each public school are usually recorded on maps and tables:

(a) Name of school
(b) Location
(c) Date of construction and dates of additions
(d) Original number of regular rooms
(e) Number of rooms added from time to time
(f) Number of permanent rooms
(g) Capacity of regular rooms
(h) Number of permanent seats
(i) Grades in school
(j) Enrollment and attendance
(k) Seats needed or now vacant
(l) Present population in school district
(m) Area of plot in acres including building
(n) Net play area now needed

From the above data, the "enrollment factor" can be calculated for each elementary school district. The enrollment factors represent the proportion of the total school district population enrolled in the various schools and control the prognostication of future enrollment from future population figures. The method of using separate enrollment factors for comparatively small areas of the city proves to be simple and effective. They can be determined empirically to include various considerations which govern the school enrollment in any particular district and to reflect characteristics as to class, nationality and social and economic status of the people inhabiting the district. There being little probability that the character of most of the various districts will undergo much change in the future (thanks largely to zoning), the application of such enrollment factors would seem to present a fair approximation of future local conditions.

For the new school districts, the enrollment factors would be determined by comparison with existing school districts of similar character for which the enrollment factors were known. In a typical case the enrollment factors for elementary schools (first to sixth grades) show a variation from 3.8 per cent to 12.8 per cent, the average for the entire city being 8.7 per cent. Comparison of the various enrollment factors with the character of the corresponding districts shows that in addition to the individual characteristics of the various districts already referred to, such elements as parochial enrollment from strong Catholic neighborhoods, and private school enrollments from certain classes of neighborhoods, also find expression in the enrollment factor.

The enrollment factor used in connection with junior high schools can be derived from a comparison of the total enrollment in the seventh, eighth and ninth grades throughout the city with the total city population. Junior high school districts are necessarily so large that special local characteristics tend to counteract each other within each district. An average enrollment factor is about 3 per cent. In a similar manner 2 to 2½ per cent is an average enrollment factor for senior high schools.

Before proceeding to the distribution of schools and the mapping-out of future school districts, certain standards should be agreed to concerning the desirable size of schools and also concerning the minimum play-yard space needed per pupil. These would differ with local habits and points of view.

Standards

1. A desirable size for city elementary schools is one with a seating capacity of 800 or possibly 1,000 pupils.

Such schools, we are told, are proving to be equally satisfactory from an educational standpoint and from the standpoint of administration. In consideration of the above, every effort should be made to determine future school districts so as to keep the enrollment in the schools within the limits just mentioned.

However, it is bound to happen that the estimated future enrollment for some of the elementary schools does not exceed a few hundred pupils. In some cases where the school districts are isolated by natural boundaries or artificial barriers (such as heavily traveled thoroughfares and railroad lines), or in the central district where the population is decreasing, or in the outlying districts that will not be likely to be built up at all completely even by 1950, smaller schools would be necessary. Manifestly, the enrollment figures for the schools in the type of district last named do not represent the ultimate school capacities needed.

The size of junior high schools would normally be kept under 1,500 seats, although there appear to be few objections to somewhat larger buildings.

The maximum size for a senior high school is assumed as 2,500 or possibly 3,000 pupils, although 5,000 pupils is not considered to be an impossibility.

2. The capacity of regular classrooms used in the calculation of the number of rooms needed would be assumed to be 40, 35 and 30 respectively for elementary, junior high and high school grades, unless local practice proved the desirability of a different standard.

3. Play-yard space should be provided in connection with each elementary and junior high school on the basis of a minimum of 75 square feet per pupil in the elementary schools, 100 square feet per pupil for the junior high schools, and 150 square feet per pupil for senior high schools.

4. To provide for the proper setting of school buildings, for adequate playground space and for possible future expansion, 3 to 4 acres should be assumed as the minimum size of plot for new elementary schools, 6 to 10 acres for new junior high schools and 10 to 20 acres for senior high schools, although even larger plots are highly desirable wherever land is cheap enough.

Factors to Be Considered in Selecting School Sites

Knowing the number of needed school buildings and rooms in any particular district, the most advantageous locations for each should be selected and a decision made as to whether it would be preferable to retain existing schools and reconstruct or extend them as needed, or whether it would be more desirable to abandon the existing school and start afresh.

Throughout such studies as these the following factors should be considered:

1. Adequate size of plot
2. Practicable shape of plot
3. Topography and setting
4. Reasonable cost of land
5. Least number of existing improvements to be removed
6. Dryness of ground and foundation conditions
7. Avoidance of areas subject to flood
8. Adequacy of possible playground development on the same or adjacent site
9. Possibilities of using other existing public playgrounds or other city-owned properties
10. Avoidance of business and industrial districts and uses
11. Avoidance of nuisances and hospitals and cemeteries
12. Avoidance of the dangers of thoroughfare traffic and railroad grade crossings
13. Location central to school district
14. Accessibility
15. Nearness to existing and proposed thoroughfares, transit and bus lines
16. Harmony with surrounding architectural development
17. Possible incorporation in a local grouping of public and semi-public buildings

Planning for the Future

As the next step, the population of the tentative new school districts should be determined from the Population Spot Map. By the application of the enrollment factor, in the manner already explained, the tentative enrollment figures can be calculated. By a process of adjustment, the district boundary lines and enrollment figures can be made to approximate the requirements and standards already referred to.

Generally speaking, the same course can be followed in revising the limits of existing school districts and in checking the adequacy of existing school facilities where retained and also the size of additions where needed.

Typical results of these calculations are shown in the accompanying School and Playground Table. In the same table is presented, by five-

SCHOOL AND SCHOOL PLAY YARD PROGRAM

School	Location	Grades Using School	Dates of Erection and Alteration	1925 School Conditions: Number of Permanent Rooms	Seating Capacity of Permanent Rooms	1925 Total Registration	1925 Average Daily Attendance	Excess Seats Available for Growth	Date When Will be Used to Capacity
Edison Grammar	Rectory & Locust	K-7	1897-1906-'10	14	560	558	467	73	1928
Irving Grammar	Irving & Hancock	K-6	1899	18	640	532	456	84	1929
Lincoln Grammar	Central Avenue	K-6	1897-'99-1906	16	640	459	421	219	1936
Roosevelt Grammar	Pearl & William	K-6	1910-1915	9 & 8	680	545	464	216	1936
Washington Grammar	S.Regent at Olivia	K-7	1906-1923	8 & 8	640	530	476	164	1930
Horton Grammar	Grace Church & Eldridge	K-6	1923	16	640	640	620	20	1927
1925 Grammar Totals				94	3,700	3,284	2,627	776	Av.1932
Central Junior High	Irving Avenue	7-8	1921-1923	13 & 12	840	804	701	139	1931
Grand Total 1925 Grammar				119	4,540	4,088	3,328	915	

School	Location	Grades Using School	1930 School Estimates (Includes Annexed Area) Including 7 and 8 Grades in Grammar: Average Daily Attendance incl.7 & 8 Grades	Additional Seats Needed incl.7 & 8 Grades	No.of Rooms to be Added on or Before 1930	1936	1940	1945	Play Yard Estimates: Acres in Plot in 1925 Total	Play Area	Added Play Acres Needed 1925	1930	No.of Acres to be Added on or Before 1930	1936	1940	1945
Edison Grammar	Rectory & Locust		938	380	10				0.4	0.1	0.7	1.65	1.8			
Irving Grammar	Irving & Hancock		Transfer to Central		Abandon in 1940				0.5	0.2	Add to Central School Play Yard					
Lincoln Grammar	Central Avenue		560	20					0.4	0.1	0.65	1.1	Use Purdy Pk.		0.5	
Roosevelt Grammar	Pearl & William		656	None					0.5	0.2	0.7	1.0			1.0	
Washington Grammar	S.Regent at Olivia		567	327			8		0.7	0.4	0.6	1.3				1.8
Horton Grammar	Grace Church & Eldridge		565	None					2.9	2.8	None					
1925 Grammar Totals			3,816	745					5.4	3.8	2.55	5.05				
New Ironhyl Grammar	Ironhyland at Wesley	K-8	787	787	20						1.4		2.8			
New King St.Grammar	King at Leicester	K-8	684	684		17					1.25			1.75		
New South Grammar	S.Main beyond S.Regent	K-8	506	506		13					0.9			1.0		
New N.E.Grammar	Between King & N.E.Park	K-8	936	936				24			1.75		Use N.E.Park			1.0
New S.W.Grammar	High View & Dixon	K-8	801	801				20			1.45					2.5
1930 Grammar Totals			3,713	3,713	112 rooms in all											
Central Junior High	Irving Avenue		801	None					0.5	0.2						
Grand Totals 1930 Grammar			4,513	3,713	112 rooms in all				5.9	3.7	2.55	11.90	15 acres in all			

SCHOOL AND PLAYGROUND TABLE

year periods, a program for school additions, for the erection of new schools and also for the acquisition of land for school and play purposes.

In the preparation of such a program, schools should be considered in groups of three or more ultimate school districts, and it should be assumed that during the building-up of the school system, the district boundaries will be adjusted to the various steps of the school-building program. Keeping this thought in mind, it is reasonable in certain cases to recommend speeding-up additions to more centrally located existing schools and developing them to their ultimately needed capacity, thus staving off the erection of new school buildings in the more outlying districts. Conversely, in other cases where it would be reasonable to abandon and relocate the existing school instead of building additions to it, the date of construction of a new school farther out or the date of additions to nearby existing schools could be advanced, to take care of the increasing enrollment of the old school to be abandoned. By following this course it would be possible to delay the relocation of the old school and reduce the loss incurred by its abandonment.

The dates recommended for the acquisition of land for new schools or additions or for play yards should be primarily dependent on when the new school facilities would be needed. In addition, consideration should be given to the character and location of recommended sites. Wherever a desirable unimproved site is situated in a fairly well-developed district where the choice is limited, it will be advisable to acquire the plot needed before it is developed privately and its acquisition made prohibitive.

Dayton as a Typical Example

A typical school study of the sort above discussed was made for Dayton, Ohio. It showed that the enrollment in 1924 and in grades one to eight inclusive exceeded the seating capacity of the regular rooms by 4,820. This corresponded to a deficiency of about 120 rooms in the elementary schools.

Disregarding the kindergarten grade as well as the normal, pre-vocational, and special schools, the night school enrollment and the enrollment from outside of the city school districts, the 1923-1924 enrollment in the public schools amounted to 22,860 pupils, based on the average monthly enrollment as furnished by the Board of Education. The estimated population figure for the city for the same year is 169,000. The population growth studies give 340,000 persons as the probable population in 1950, with a corresponding public school enrollment of 46,100 pupils. On the basis of the average enrollment factors given hereinbefore, the composition of this future enrollment was found as follows:

Elementary Schools (Grades 1 to 6)	29,300
Junior High Schools (Grades 7 to 9)	10,000
Senior High Schools (Grades 10 to 12)	6,800

Thus, as has already been mentioned, on the average 22 to 25 rooms would be needed annually to take care of the 860 pupils that represent the average yearly increment in enrollment. In all, about 600 rooms will have to be added during the next 25 years to accommodate the increase in enrollment, plus 120 to make up for the deficiency now existing, or 720 rooms altogether. As may be noted in the accompanying School and Playground Table, an addition of 814 rooms is provided for. However, the program includes the rebuilding of four elementary and two senior high schools.

The summary of the recommendations for new schools, for additions and for land acquisition is presented in the two tables below:

Number of Rooms to Be Provided Before 1950 in Periods of Five Years

Type of School	*In or Before*					*Grand Total*
	1930	*1935*	*1940*	*1945*	*1950*	
Elementary	110	89	97	71	52	419
Junior High	120	44	22	26	26	238
Senior High	..	70	87	..	..	157
Total	230	203	206	97	78	814

Total Acreage to Be Acquired Before 1950 in Periods of Five Years

Type of School	*In or Before*					*Grand Total*
	1930	*1935*	*1940*	*1945*	*1950*	
Elementary	13.20	13.45	7.70	4.15	..	38.50
Junior High	16.10	7.30	..	..	..	23.40
Senior High	..	12.40	20.50	..	..	32.90
Total	29.30	33.15	28.20	4.15	..	94.80

In conclusion, it is desired to emphasize that each of the specific recommendations made in this report and in the School and Playground Table is typical rather than specific.

In connection with recommended sites, they are intended to show the kind of site and the location that is desirable rather than the particular property to be acquired. It is always to be expected that when the School Board has arrived at the point where it is actually ready to purchase any particular new site or an extension to an existing one, it would use these recommendations as a point of departure. Furthermore, the actual size and shape of grounds as shown on the tentative City Plan Map and in the table are typical rather than specific and again can be varied, depending on conditions as they may be at the time when the Board of Education is ready to purchase the property.

It is further understood that the recommended dates of acquisition or construction are also typical and relative. Any detailed prognostication as to the intensity and rate of growth of such a small specific area as a school district, is sure to have to be revised from time to time as the district develops. However, in the aggregate, these districts are likely to average out approximately as indicated.

In many cases, it is recommended to build new schools or to construct the additions to existing schools in units of four rooms or over, in periods of from ten to fifteen years. It is understood that the school should be designed at the start for its ultimate size and that these additions should be built as units of the ultimate building.

THE NEW SWIMMING POOL OF BALTIMORE CITY COLLEGE, BALTIMORE, MD.

Features of the Design of the New Swimming Pool of Baltimore City College

BY HENRY G. PERRING

ARCHITECT AND ENGINEER, BALTIMORE, MD.

THE swimming pool of Baltimore's new City College must strike with delight all who gaze upon its placid surface, yet varying feelings will follow the first joy of just looking.

The boys in the school hail with pleasure the beautiful pool and begin to gloat over their less fortunate fellows in other schools that do not have this great prize. The School Board member may think of what its cost represents in terms of elementary classrooms in an overcrowded school system, and wonder what its upkeep will be in values of school supplies. The Principal may think of the added cares in administration in this place where boys will be boys. The taxpayer may vaguely wonder what its cost and upkeep represents in the lower corner of his tax bill. The contractor may think of the difficulties of construction; the humanitarian of the wonderful opportunity for healthful recreation and the facilities for teaching hundreds of boys to swim.

All are interested according to their points of view.

As an engineer thinks of it, all these phases pass in quick mental review, and then come the queries: How is it built? How does it work? How sanitary is it?

The Baltimore City College is a senior high school primarily devoted to the arts. Its history has been for years the history of Baltimore, and its alumni include about nine-tenths of the brightest and best minds of the city.

When a school program was decided upon as a result of a large school loan, it was inevitable that the Baltimore City College should have a new building of the finest. It was of course necessary to have a swimming pool, that pool to be

in keeping with the building—of the best, clean, sanitary and capable of accommodating swimming matches of national record.

The building is located upon a site in northern Baltimore. Forty acres of land constitute its grounds, and the beautiful Gothic stone building, set off by a massive tower, is one of the noted structures of the city in architectural beauty. Its capacity is 3,000 students, and it cost a little over $2,000,000.

In the basement is the swimming pool, adjacent to and connected directly with locker-rooms, showers and dressing-rooms. The basement is half in and half out of the ground so that light and air from the court on one side and the exterior on the other are available the full length of the room. Not that this natural air supply means much ordinarily, for a fan system furnishes to the whole school, including the swimming pool, copious quantities of filtered, heated, humidified air, while other fans exhaust the vitiated atmosphere. The gymnasium is on the same floor, so that the athletic, bathing, toilet, swimming and dressing facilities are in close proximity, of ample size and in proper sequence. The room in which the pool proper is located is 138 feet long, 59 feet 6 inches wide, with a spectators' gallery rising from 3 feet above the floor, 3 tiers high by 100 feet long, capable of seating about 200 people. The span of the room is clear and the heavy girders above the ceiling carry three floors above. A white, non-slip tile space on each side of the pool 5 feet 9 inches wide and a space of 18 feet at the deep end, 9 feet 6 inches at the shallow end, give ample space for landing and standing.

The pool itself is 125 feet long and 48 feet wide, varying in depth from 4 feet at one end to 9 feet at a line 15 feet from the other end, the end depth here being 6 feet. The arched ceiling is 15 feet above the floor and is finished as are the walls in white cement.

The pool is of reinforced concrete, resting on the ground but with a passageway around the walls for inspection. It is waterproofed with five plies of heavy felt and asphalt mopped on hot with scrupulous care. The bottom was protected with boards after waterproofing and while the white brick were being laid. This latter job required great care and skill, each line of brick being exactly parallel to the adjoining one so that the lines of black brick forming the divisions between swimming lanes were exactly straight and parallel. The inlet and outlet fixtures were set by the plumber and carefully flashed and waterproofed. Before the glazed brick lining was laid, the pool was tested for forty-eight hours and any leaks developing were to be corrected and the pool again tested, and so on, until with the pool full of water no leak showed in forty-eight hours. The difficulties here were the concern of every one connected with the construction of the pool but are of little interest now. Suffice it to say the pool was made tight by a willing contractor, in reasonably short time, and the bricklaying proceeded.

Below and back of the deep end of the pool is the machinery room where are located recirculation pumps, filters, heaters and sterilizers. The pumps in duplicate are the direct-connected centrifugal type with impellers designed to pass hair, lint, etc., and discharge 265 gallons of water per minute against a 35-foot head. A thermometer on the pump inlet gives the temperature of the water running from the pool.

The heater is capable of heating 15,900 gallons of water per hour from 40° F. to 80° F., using steam at 40 pounds pressure, the drop through the heater not to exceed 10 pounds. The heating surface is of copper tubing designed to stand a working pressure of 100 pounds. An automatic temperature regulator is supplied to maintain the pool at 72° F.

Three filters are installed, two for use and one for reserve while cleaning one of the others. These filters are of the sand and gravel type, designed for a working pressure of 100 pounds. A back pressure valve is located on inlet and chemical pressure tank arranged to feed alum to the water automatically as it passes on the way to the filters. Suspended matter is collected and turbidity and color corrected, which can be checked at will from sampling cocks.

The sterilizer is capable of sterilizing 15,900 gallons of water per hour, by the use of chlorine.

So the engineer's questions are answered. It was an interesting matter of nice handling to build the pool. The mechanical apparatus does all it is expected to do. And—the water is kept purer than certified milk.

The flushing and cleaning devices and the glazed brickwork and special glazed scum gutter were furnished by Francis Booream, who took the greatest interest in the design and construction of the pool.

The building and pool were designed by Buckler and Fenhagen, architects. The work was designed and constructed under the supervision and direction of the writer as Supervising Engineer of the Public Improvement Commission of Baltimore.

HEATING AND PURIFYING EQUIPMENT USED

Heater—Griscom-Russell Co.
Filters—Wm. B. Scaife & Sons Co.
Sterilizer—Wallace & Tiernan Co., Inc.

EXTERIOR OF UNIVERSITY OF IOWA FIELD HOUSE

The Field House of the University of Iowa

BY P. E. BELTING

DIRECTOR OF ATHLETICS, STATE UNIVERSITY OF IOWA

THE Board of Education of the State of Iowa, on October 16, 1925, authorized the Athletic Council of the University to proceed with the erection of a Field House according to preliminary plans that were presented and accepted at that time. Thereupon, the Athletic Council issued $300 000 5 per cent Field House serial gold bonds, with which, in addition to moneys already received or available from athletic contests, to finance the construction of the building.

Structural steel was purchased in December, excavations and footings were begun in February, steel was being erected in March, the general contract was let in April, and the building was ready for use, December 1, 1926.

This is the largest structure of its kind in the world. With a length of 464 feet north and south, a width of 430 feet east and west, and with an average height of 60 feet, the Field House contains 5½ million cubic feet of space. Sixteen hundred fifty tons of structural steel, 500,000 face brick, 2 million common brick or their equivalent in tile, 36 carloads of lumber, and thousands of barrels of cement and lime, were required to enclose the building, together with the new Armory, covering over three acres of ground.

The Field House is composed of four sections: the first is the gymnasium on the north; the second is the swimming pool on the south; the third is the field house proper between the gymnasium and the swimming pool, and the fourth is the exhibition hall and offices across the front of the building.

Gymnasium and Swimming Pool

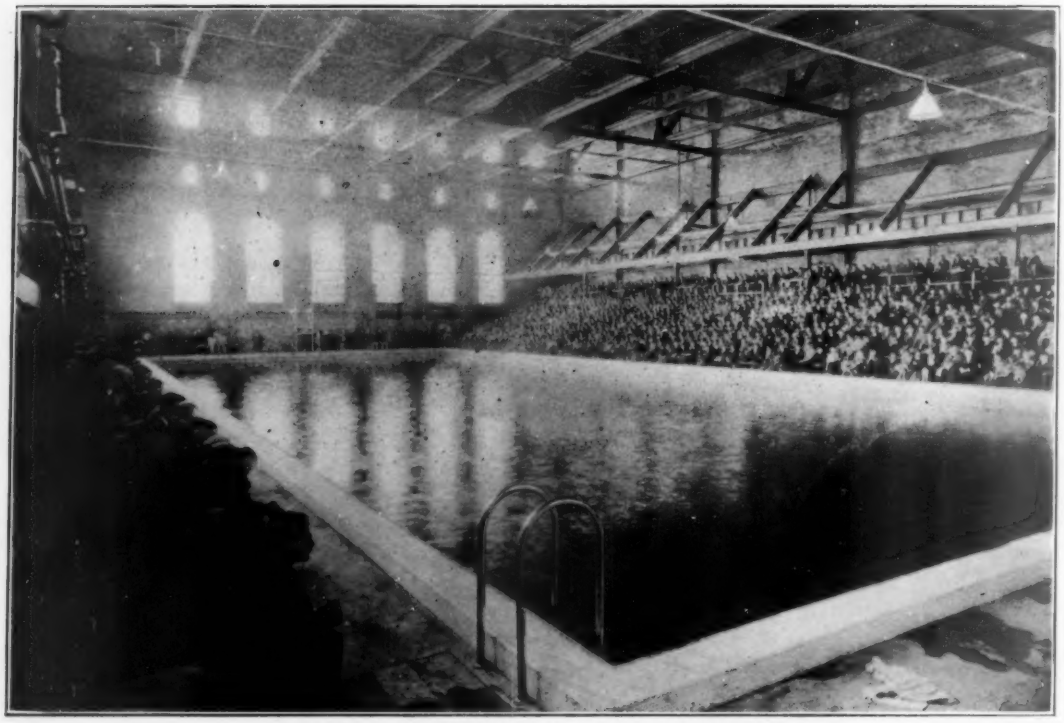
The gymnasium is 112 feet wide, 180 feet long, and 50 feet high. The locker room on the basement floor contains 5,000 lockers, 50 showers, toilets, drying-room, varsity and freshman team rooms, faculty and coaches' quarters, and a large suite of offices for the medical supervisors. Above the main gymnasium floor sixteen hand-ball and squash racquet courts, together with eight classrooms, were constructed.

The south wing, containing the swimming pool, is similar in dimensions to the gymnasium. The pool itself is 60 feet wide, 150 feet long, holding approximately 500,000 gallons of water, and containing 9,000 square feet of water surface. If each swimmer were allowed 35 square feet of space, 250 people could use the pool at one time. The pool is constructed in such a manner as to provide accommodations for all types of activities in swimming to be carried on simultaneously. Surrounding the pool will be two decks of seats to accommodate 3,500 spectators, which is a feature found nowhere else around an indoor pool.

The Field House Proper

The field house proper, lying between the gymnasium and the swimming pool, is divided in such a way as to have a span of 150 feet, on either side of which are located three decks of seats, which, together with the ramps, are 45 feet in width. The seatings will accommodate about 12,000

INTERIOR CONCOURSE, UNIVERSITY OF IOWA FIELD HOUSE



A CROWD OF SPECTATORS AT THE SWIMMING POOL

people around the basketball floor, with sufficient passage way for the largest crowd to leave the building in four minutes. Encircling the basketball court in the east end of the building and continuing around the inside edge of the new armory, the largest indoor cinder track in the United States has been constructed. This track is six laps to the mile. On either side of the building, there will be a length sufficient for two 100-yard straightaways with ample room for starting and finishing. The field house proper and the new armory together provide a space large enough for eight regulation tennis courts, a football field, a baseball diamond, a soccer field, jumping and vaulting pits, and other activities that may be developed.

On the ground floor of the section of the building, across the front of the Field House, is located a large exhibition hall, 240 feet long, 30 feet wide and 18 feet high, for the display of the trophies of victorious athletic teams and the group and individual pictures of the athletes of the University of Iowa. Above the exhibition hall, two stories of offices and classrooms are constructed for the general administration of the various activities of the Division of Physical Education.

The University of Iowa, as an educational institution, is composed of the Graduate College, Colleges of Liberal Arts, Education, and Commerce, the Schools of Music, Nursing and Journalism, the Child Welfare Research Station, the Summer Session, the Extension Division, the Division of Maternity and Infant Hygiene, and the Division of Physical Education. The latter organization consists of the departments of Physical Education for Women, Physical Education for Men, Intramural Athletics, and Intercollegiate Athletics. The Field House provides for much of the work of these departments.

The Problem of Adequate Elementary School Playgrounds

BY W. N. SELLMAN

PRINCIPAL, WYMAN SCHOOL, ST. LOUIS, MO.

THE playground, once merely a part of a school plant, to which children were sent to relieve both teacher and child from classroom activities, is coming to be recognized as an integral and necessary factor in the complete education of the individual and of the groups. The playground makes for bodily and mental health. It is the home of freedom, initiative, tolerance and emulation—all moving within a sphere of good fellowship. It develops character. It makes for democracy.

The Cleveland Survey revealed that the average child spends 1,000 hours per year in school, and 1,800 hours per year on the street—playground, park, vacant lot, waterfront, or the actual street. Other studies have resulted in similar findings. Accident statistics for St. Louis show that most accidents to children of 5 to 18 occur between 4 and 6 P.M. Dr. O'Shea writes that *gang* impulse is the same as *team* impulse, and that inadequate playground space is a contributory factor to juvenile delinquency.

Chicago spent more than $20,000,000 in establishing 57 recreational centers, including playgrounds, athletic fields, swimming pools, etc., for the entire community. New York, St. Louis, Baltimore, in fact, all the larger cities, have spent vast sums to provide playground facilities for at least certain sections of the cities.

Gary, Ind., and some of the smaller cities, conceived the idea of combining school and municipal energies. They believe the school location to be the natural location for a recreational center, and hold it to be both efficient and economical to pool resources in one adequate plant that fills the educational and recreational needs of both the school and community. Chicago, after experience, has decided it is municipal economy to use school plants as recreational centers, and administrative efficiency to center control of recreational centers in the Board of Education. The municipal recreational centers of Chicago are now administered by the Board of Education. School executives are insisting upon an adequate playground for every school. Students of child and social welfare are just as insistent that playground facilities be provided for after-school hours—those most hazardous hours—and that buildings be made available for recreation during evenings.

The tendency is clearly toward extending playground opportunities beyond the school day for school children and making recreational opportunities available for the whole community. By whom, then, should playground and recreational facilities be provided and administered? Is the dual system (city recreation commission and school board) most economical and efficient for society? The President of the Chicago West Park Commission reports that it is municipal economy to use school buildings and grounds for recreational centers. Providing and maintaining special buildings and grounds largely duplicates cost. The economy and enlarged opportunities of the Gary plan lead to the same conclusion. The distance standard used by most authorities in locating elementary school sites is one-half mile. It is

a known fact that children make little use of playgrounds that are more than one-half mile from their homes. The distance standard, then, for playgrounds and elementary schools is practically the same. Hence, the elementary school playground and the recreational playground can, for economy and efficiency, be on the same location. In districts where school population is very dense, and where natural or artificial barriers, such as rivers, lakes, very irregular topography, railroads, congested traffic, etc., exist, the problems of location are the same for school and recreational playgrounds.

It seems reasonable, just plain common sense, that the school ground should fulfill the maximum playground needs of both school and community. These needs involve several factors, among which size, equipment and supervision take precedence. Much has been written, and much said, relative to the size of a playground that is adequate for an elementary school. There are elementary schools in rural districts with 10 or 15 children in daily attendance. There are elementary schools in New York City with approximately 5,000 children in daily attendance. What standard of adequacy could or should be applied to these extremes? The most accepted standard at present is 100 square feet per child. This standard applied to our extremes would call for 1/29-acre for the rural school where land is comparatively cheap, and 11½ acres in New York City, where land costs more than $1,000,000 per acre. There should probably be no rural school with 10 or 15 pupils; consolidation should prevail. On the other hand, the 5,000-child school is too consolidated, at least to have anything like adequate playground space.

The Delaware Board of Education rules that a one-room school site shall not be less than two acres. London requires 30 square feet of playground space for each child and is attempting to get it by buying adequate grounds at a distance where costs are not prohibitive and transporting children to and from the playgrounds at reduced rates when normal traffic is in the opposite direction. New York, Newark, and San Francisco are using roof and ground-floor playgrounds, thus adding approximately twice the area of the building to the open-air courts, etc., that are necessary for light and as protection from street and neighborhood noises and odors. The ground floor space has no sunshine; the roof has light and sunshine. It is easy to control but is inaccessible for after-school hours, on holidays and during the summer. The construction of a roof playground is difficult and expensive. It should probably not be resorted to unless the cost of the site is equal to the cost of the building. Salt Lake City has aded to its school playground facilities by buying areas in the interior of blocks, cutting off 50 to 100 feet from the rear of house lots. Some schools are thus securing playgrounds of 3 acres in size. The difficulties encountered and high cost incurred in providing play space in these congested and unusual situations might have been in a large measure averted, had a forecast of child population been made and sites adequate for present conditions been purchased twenty-five to fifty years ago. As land values usually rise as population increases, there is a greater probability of gain than of loss in purchasing school sites some time ahead of need. Accurate forecasting and purchase of school sites anticipatory to enrollment needs has proved to be wise economy. If the population trend changes, a slight loss may be realized. However, when a board of education purchases an adequate site for a large school, realtors use this information as selling talk, and the district is relatively certain to build up, thus increasing the money-value of the site. This fact has been substantiated by expert realtors in St. Louis.

Inadequate playgrounds found today are in general the result of lack of foresight on the part of school boards or school administrators. The error should be rectified. Adequate playground opportunities should be given every elementary school district, unless the cost is really prohibitive. In general, even in most large cities, the cost can be justified by benefits derived. The location and size of school sites selected today should provide adequate playground facilities for at least fifty years to come. School population forecasting has been carefully developed and is dependable. There is no economy in purchasing a small site adequate for a present 200-pupil school that will become a 1,000-pupil school. Here, again, the application of a per pupil standard meets with a difficulty. The 100 square feet per pupil standard should be applied to the maximum enrollment indicated by the forecast.

Use of the playground after school hours by the community should also be considered in determining its size. Available data indicate that about 25 per cent of the school enrollment use playgrounds after school hours. Most of these are the older and larger children whose interests center in organized team activities—playground baseball, soccer, basket-ball, etc. These activities require large playgrounds. The number of members of the community who do not attend the elementary school, but who should be given playground opportunities, is still larger and demands larger playground space. It is desirable, and I think reasonable, to set up five acres as the minimum requirement for playground space for an elementary school community in a normal situation whose school enrollment will be at maximum about 1,000 children.

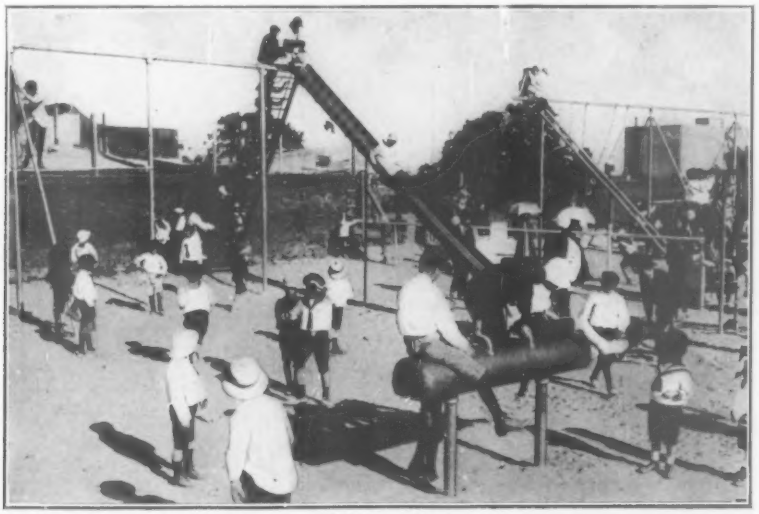
The playground should be adjacent to the school building. Toilet, lavatories, shower-baths, dressing-rooms and equipment storage facilities should be available on the ground floor of the building. It is not well to have other parts of the building accessible, unless being used contributory to the playground activities. The playgrounds should be divided into three sections, the largest used as an athletic field by the larger boys, the others used by the girls and smaller boys respectively.

Courtesy of Hill-Standard Co., Anderson, Ind.

MANY KINDS OF PLAYGROUND APPARATUS ARE AVAILABLE FOR SCHOOLS

It is desirable to place the building at one side of the site, probably 25 feet from the street, and faced so it will afford proper light exposure for the classrooms, at the same time shading part of the playground. A lawn with effective landscaping should occupy the space between the front of the building and the street. Ample galvanized iron playground equipment, etc., should be installed in locations that do not interfere with team activities and athletic events. It is well to have certain sections shaded by trees, especially for the older girls. The playground should be fenced by an 8-foot chain-link fence set in concrete. Beauty can be added by planting rambler roses on the outside of the fence at advantageous places. The landscaping in front of the building, the ramblers on the fence, and the layout of the whole site, including playgrounds, should be a model in community housekeeping.

The adequate size, ample equipment and beautiful landscape of the recreational unit are insufficient. There must be trained leadership effective every minute the playgrounds are open. The values mentioned in the early part of the paper are not just happenings. They are developed by effective playground directors. The fact suggests further advantages to be gained by school board administration of recreational centers. Teachers especially trained in child leadership enter into playground and recreational work more frequently when it is controlled by the board of education. School authorities take advantage of the great educational possibilities, physical, mental, moral and social.



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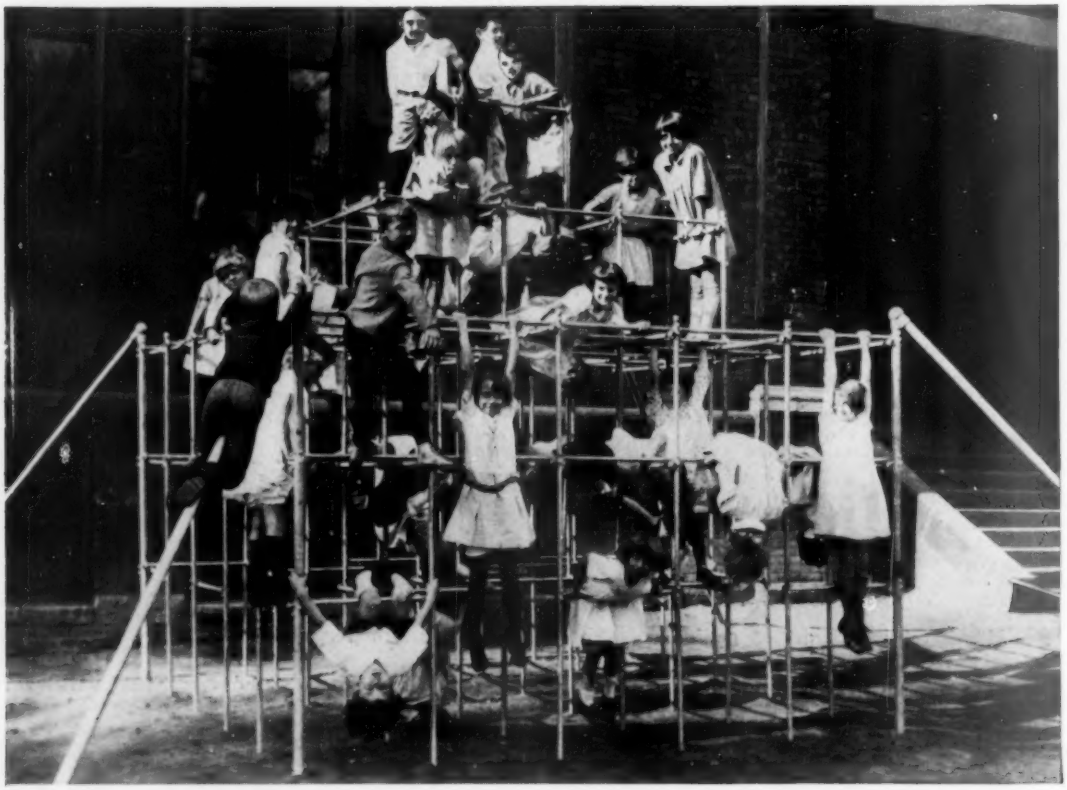

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For school yards or public parks, or the playgrounds that are not supervised the year 'round, the JUNGLEGYM is ideal. Good fun and healthful exercise all the time and through every season.

The JUNGLEGYM structure is patented in the United States, October 23, 1923, and March 25, 1924.

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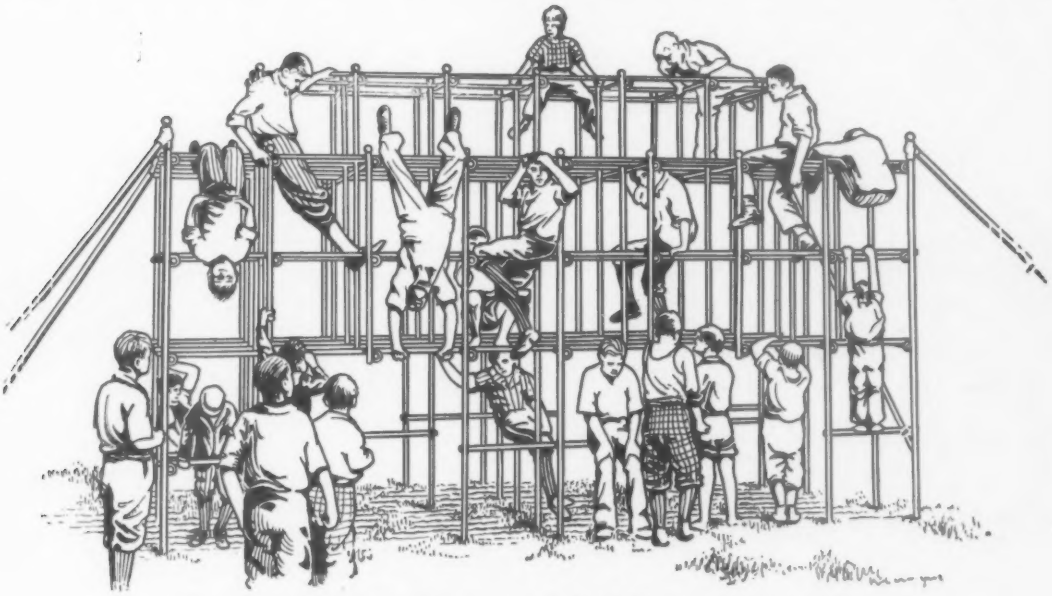

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"Has never been an accident. **Think it the safest piece of apparatus made.**"—Neva L. Boyd, Director, Hull House, Chicago.

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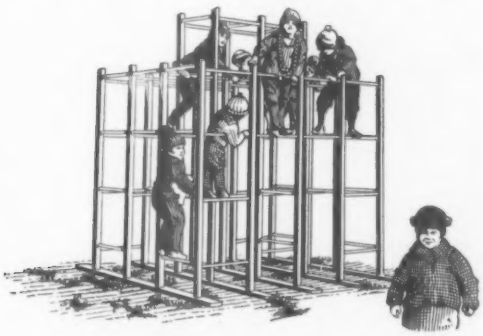
"Children do not tire of Junglegym. Absolutely safe to play on."—J. S. Wright, Director of Physical Education, Chicago, Illinois.

"We recommend it heartily. **Entirely safe.** Interesting to the children."—Margaret F. Coe, Supervisor Intermediate Dept., The Park School, Baltimore, Md.

"Our little boys like the Junglegym as much as ever."—Edward E. Allen, Director, Perkins Institute for the Blind, Watertown, Mass.



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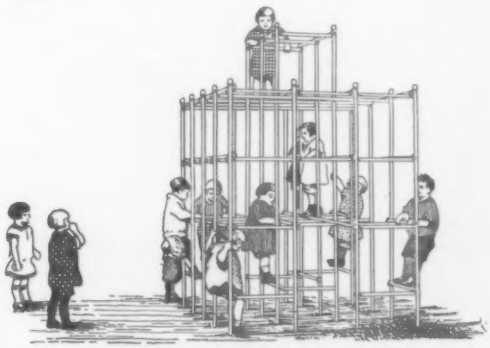

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GALVANIZED STEEL PIPE—$125.00
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Spalding equipment is rugged. "Good enough" will not do—it must be of the highest quality.

Spalding equipment is carefully and scientifically designed. The various pieces are made to be just right for the children who are to use them. Sizes and spaces are correct, materials of full strength with a large factor of safety, design clean to avoid any danger from projecting pieces, bolts, nuts, etc.

PLANS

We offer, without charge or obligation, engineering service on designing complete recreation layouts. It is only necessary to give us all facts available, sketch of grounds with dimensions, and if possible, the topography contours.

PRICES

We are prepared to figure on supplying and installing the complete equipment of apparatus including pipe frames.

If preferred, we will quote on all apparatus and frame fitting of design f. o. b. factory or freight paid to destination. In such case we will supply all necessary erection instructions and blue prints, also complete specifications of galvanized pipe required to construct frames so that you can obtain the correct type and sizes of pipe from local supply houses.

GENERAL OBSERVATIONS

Playgrounds should be placed at points convenient to the children, as, for instance, near to the schoolhouses, assuming that they are properly placed to serve the people most conveniently. Experience has shown that children will not, in any number, travel more than a quarter of a mile to a playground.

Boys and girls should have separate spaces. Fences should be used, one gate entrance to each, to give the director full control. Playgrounds of all kinds should have a trained play teacher in charge, not a policeman or janitor.

The smaller children under ten can usually be counted on to play in one corner of the girls' space. Usually an older sister has them in charge. Also the type of play and games conducted by the girls is safer for the little ones. In this corner we should have a sand pit and a shallow wading pool.

Sanitary bubble drinking fountains should be provided in each of the spaces.

Comparatively few playgrounds are properly shaded. **Trees are absolutely needed** in the hot days of summer if the playground is to be used. A bare, hot playground is about the most unattractive spot in the city.

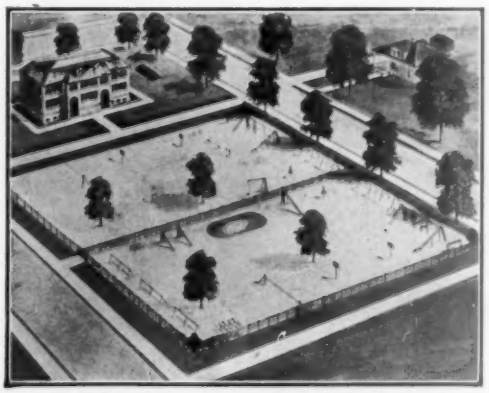
We show here by way of illustration a suggestion for a neighborhood playground embodying some of the special desirable features mentioned.

Observe the low fence around swing frames. This will serve greatly to prevent accidents to children from running heedlessly into the flying swings.

We shall be pleased to correspond with you in regard to any recreation plans or developments.

Service Bulletins giving special information on any detail of recreation promotion or facilities, standard or typical plans in blue-print form of athletic fields, baseball diamonds, football, soccer, basket-ball, tennis courts, or special layout plans of equipment for your playgrounds or gymnasium, will be sent on request.

Catalogs sent on request.



SUGGESTION FOR A NEIGHBORHOOD PLAYGROUND ADJOINING PUBLIC SCHOOL

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We have been manufacturing and installing the finest types of gymnasium equipment for almost forty years.

Our Engineering Department will be pleased to assist you without any obligation, on all details of the planning and outfitting of your gymnasium. We take pride in our mechanical ability to construct variations of apparatus or means of installing to give the utmost efficiency in use.

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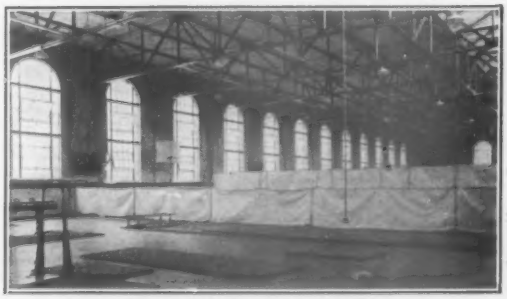
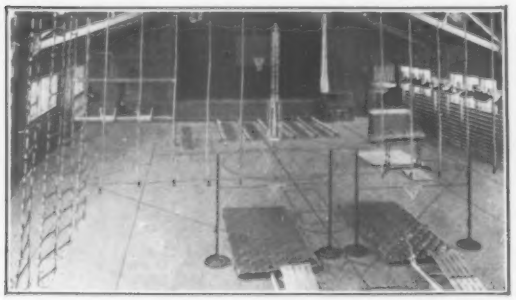
GIRLS' GYMNASIUM
WICHITA, KANSAS, HIGH SCHOOL

HUTCHINSON GYMNASIUM
UNIV. OF PENNSYLVANIA, PHILADELPHIA



HUTCHINSON GYMNASIUM
UNIV. OF PENNSYLVANIA, PHILADELPHIA



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THE FUN FUL LINE
PLAYGROUND EQUIPMENT

This well-known line is the result of our manufacturing experience of over twenty-eight years, in which time we have gained the distinction of being the largest manufacturers of children's outdoor, health building goods in the world.

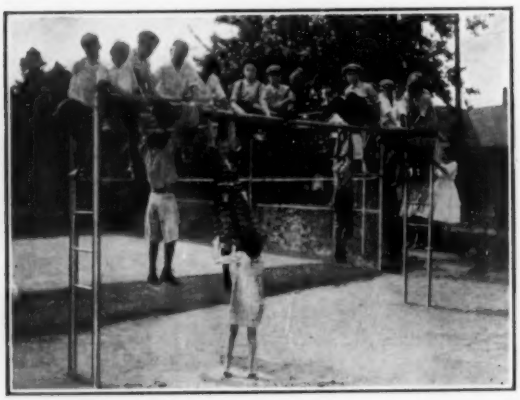
There is scarcely a city of any consequence but has a representative collection of "FUN-FUL" Playground Equipment in operation upon its public and school playgrounds.

Innumerable schools, colleges, public playgrounds and industrial plants have found our apparatus to be superior to any other on the market.

Our equipment is extensively sold by a majority of the school supply houses in the United States; and state institutions such as orphanages, reformatories and schools for the blind and feeble-minded are large users.

We have also outfitted recreation centers in many foreign countries, and a great many playgrounds and recreation fields for large organizations in the United States, such as the American Steel and Wire Company, Standard Oil Company, Goodrich Tire and Rubber Company; and some three hundred forty-odd cotton mill towns in our southern states, in addition to a number of coal mining communities.

We offer only standard approved apparatus, which we absolutely guarantee to render utmost service and satisfaction as well as best value.



The Gold Medal was awarded the Hill-Standard Co. by the Brazilian Centennial Exposition at Rio de Janeiro, 1922-23, because of the superiority of the "FUN-FUL" line of playground equipment. The receipt of a Gold Medal in competition with products of the world, is an event out of the ordinary, and a fitting tribute to a sincere and honest effort, during a long period of years, to produce the BEST for the purpose intended.

CATALOG

For those interested in playground projects we have a beautiful as well as useful catalog and other information that will gladly be sent on request. Among the large number of types of apparatus described and illustrated in the catalog are giant strides, ocean waves, merry-go-rounds, playground slides of many kinds and sizes, see-saws, horizontal ladders, traveling ring outfits, outdoor gymnasium sets, various types of swings, "barrels-of-fun," portable jump and vault standards, basket-ball backstops, goals and nets, and special combinations for playgrounds.

THE "FUN-FUL" SWIMMING POOL LINE

If you are interested in swimming pools or equipment, either of the indoor or outdoor variety, please turn to the following page.

HILL-STANDARD CO.

OUR 28TH YEAR OF MANUFACTURING OUTDOOR GOODS

ANDERSON, IND., U. S. A.

THE FUN FUL LINE
PLAYGROUND EQUIPMENT

SWIMMING POOL SPORTS EQUIPMENT

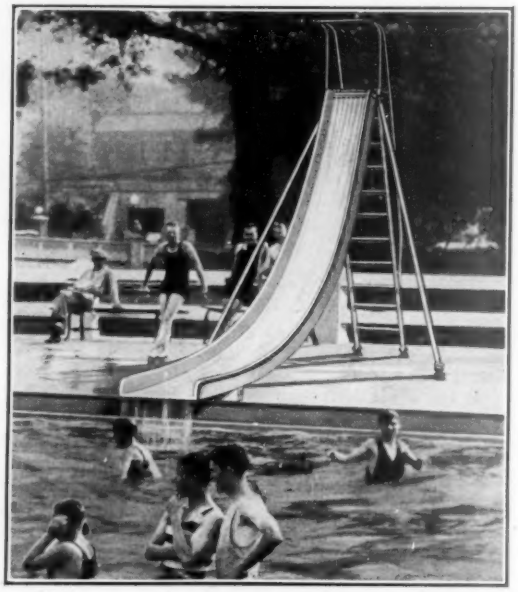
Our swimming pool and water sports equipment line is the product of almost 30 years devoted by this company to the development of health building goods exclusively. Hundreds of the most prominent pools throughout the country and in several foreign lands have adopted our goods as standard equipment.

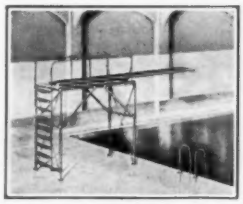
WATER SLIDES

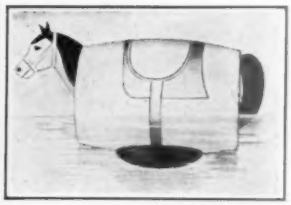
Our Water Slides for indoor or outdoor use are of three types: Pier Slides (those mounted on piers or piling), Lake Bottom Slides (those set in beds of streams, pool, ponds or lakes), and Natatorium Slides (set at the edge, and entirely out of the water). Chutes are regularly furnished with Armco ingot iron bedways, although special metals will be furnished for unusual conditions if desired.

CATALOG

Write for our catalog covering Swimming Pool and Bathing Beach Equipment, illustrating and describing a great variety of slides, as well as spring boards, landing stairs, water horses, aqua planes, diving towers, inflated rubber boats, surf boards, life lines, buoys, etc.







WALLACE & TIERNAN CO., INC.

NEWARK, NEW JERSEY

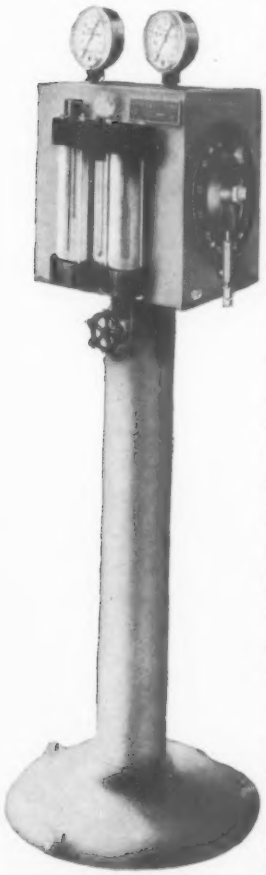
Manufacturers of Chlorine Control Apparatus Water Sterilization and Swimming Pool Sanitation

BRANCH OFFICES

Holston Bank Bldg., Knoxville, Tenn.
Great Lakes Bldg., Chicago, Ill.
Praetorian Bldg., Dallas, Tex.
Woolworth Bldg., New York City
605 Star Bldg., St. Louis, Mo.
7 Front St., San Francisco, Calif.
223 East 9th St., Kansas City, Mo.
240 South 4th St., Minneapolis, Minn.
Lloyd Bldg., Seattle, Wash.
1104 N. 17th St., Harrisburg, Pa.
714 Dime Bank Bldg., Detroit, Mich.
Fletcher Trust Bldg., Indianapolis, Ind.
Jackson Bldg., Buffalo, N. Y.
Hohm Bldg., Los Angeles, Calif.
233 Oliver Ave., Pittsburgh, Pa.
Wallace & Tiernan, Ltd., 32-34 Front St. West, Toronto, 2
Wallace & Tiernan, Ltd., 16 Water Lane, Great Tower St., London, E. C. 3
Geo. C. Robertson, Av. de Mayo 760, Buenos Aires, Argentine
Angel J. Guarello, Casilla 2809, Santiago, Chile

SWIM IN DRINKING WATER

Swimming has now become a part of the physical educational program of the modern School and University, and today all of the better Schools are equipped with a modern swimming pool. In connection with their installation — and in order to protect the health of all the bathers the modern public health engineer, in assisting an architect in the design of a swimming pool, specifies the installation of a complete water purification system — in no sense differing in principle from the water purification systems installed by most of our American municipalities.

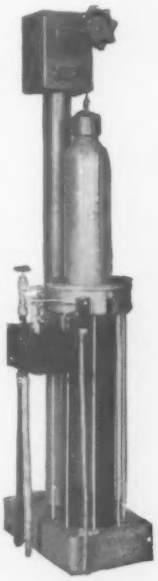


W. & T. TYPE MSP CHLORINATOR USED TO STERILIZE THE AVERAGE SCHOOL POOL

These pool water purification systems are based on the use of the water over and over again. The water is circulated continuously through the purification system, regenerated, purified, sterilized and returned to the pool. The purification system must be so installed and operated that the water in the pool is just as pure as the water drawn from the faucet at home.

"Swimming-pool water," says the Surgeon General of the United States Army, "is essentially drinking water, and must be measured by drinking water standards." The drinking water standards of the U. S. Public Health Service limit the bacteria to 100 per cubic centimeter, and in effect insist that the colon bacillus (the sewage germ) be absent in 100 cubic centimeters (3.4 ounces).

A properly operated filter will remove all of the dirt, color, turbidity and suspended material from the water and will deliver a clear, sparkling water to the pool. But a filter will **not** destroy the germs that are washed from the body of the bathers into the pool water, it will **not** destroy the microbes of disease that might get into the water from one bather, which when transmitted to other bathers cause disease.



THE W. & T. CHLORO-CLOCK USED TO STERILIZE THE SMALL POOL

Just as health authorities have found that municipal drinking water must not only be filtered but must also be **sterilized,** so, in the case of swimming pool purification the water must be sterilized. There is no possibility of disease being transmitted by a **sterilized** swimming pool water. Filtration alone **cannot** give a sterile water,—and so today we find that swimming pool sterilization is a standard requirement contained in all health regulations pertaining to swimming pool sanitation.

CHLORINATION THE BEST METHOD OF SWIMMING POOL STERILIZATION

"From all available information the addition of chlorine . . . by the use of proper apparatus, is today the most satisfactory method of pool disinfection"—so states the report of the Joint Committee of State Sanitary Engineers and American Public Health Association after five years' careful study.—And the report goes on to tell why —because of the residual sterilizing action of chlorine.

Higher endorsement could not be had.

This endorsement is because chlorination —and chlorination alone—provides **continuous** sterilization throughout the entire pool. Bear in mind that the filtered, sterilized water, the moment it enters the pool and comes in contact with a bather, is again liable to pollution which will carry through the pool, increasing as the water nears the outlet. Some means must be provided to destroy this pollution and prevent the possibility of it spreading disease during its travel through the pool.

This is accomplished by chlorination.

A properly operated pool will have in the pool water at all times just sufficient residual chlorine to destroy the microbes of disease. There is not enough to be noticed —the most sensitive bather cannot detect it. But there **is** enough there to kill a germ that is washed from the body or mouth rinsings of one bather **before** that germ can come in contact with another bather!

Convenient, simple apparatus is furnished for testing the pool water to determine the amount of residual chlorine.

Twenty-eight indoor swimming pools were recently examined by the Detroit Health Department. Three of them contained water purer than required by the United States Public Health Service for drinking water.

And **each** of these three chlorinated the water!

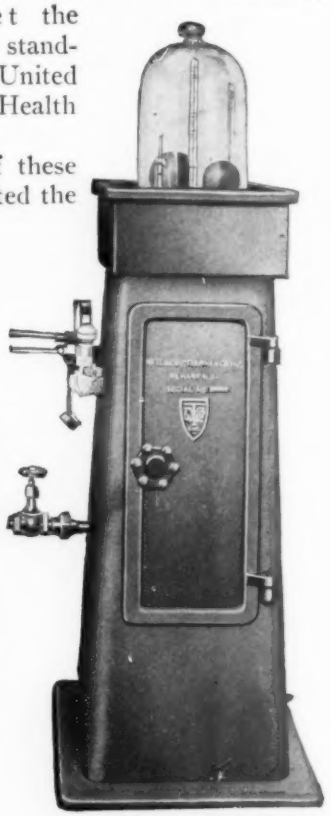
The pools were ranked in accordance with their purity.

Each of the first **ten** pools chlorinated!

Seventy-five indoor swimming pools were recently examined by the New Jersey State Department of Health. **FIVE** of them were found to contain water sufficiently pure to meet the drinking-water standards of the United States Public Health Service.

And **each** of these FIVE chlorinated the water!

The vacuum principle of control is exclusive with W. & T. Chlorinators. The operation is completely visible. Chlorine comes in contact only with silver, glass and rubber. The first Vacuum Chlorinator was shipped in 1921. It is still operating and so are all of the other two thousand shipped since then. Long life is characteristic of W. & T. equipment.



W. & T. VACUUM SOLUTION FEED CHLORINATOR TYPE MSV FOR THE VERY LARGE POOL

That is why health officials everywhere endorse chlorination.

And just as chlorination is the accepted and preferred method of swimming pool sterilization, so is Liquid Chlorine and W. & T. apparatus the preferred method of chlorination. That is because liquid chlorine is easily handled, always full strength, universally available, while the W. & T. sterilizer for controlling the application of the liquid chlorine is automatic, fool-proof, simple, durable. Once placed in operation, it stays in operation.

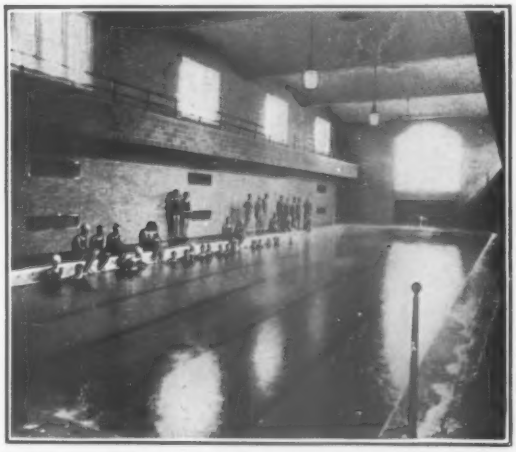
W. & T. EQUIPMENT STERILIZES THE SWIMMING WATER AT DARTMOUTH COLLEGE

Liquid chlorine and W. & T. swimming pool sterilizers remove the guesswork from swimming pool sanitation.

The sterilization of water by liquid chlorine and W. & T. equipment is thoroughly established. There are nearly 7,000 installations of W. & T. apparatus, sterilizing upwards of five thousand million gallons of drinking water each day. Every drop of drinking water delivered to over 3,000 communities in North America is sterilized with liquid chlorinee. These public water supplies through chlorination meet the requirements of the United States Public Health Service for drinking water—while in just the same manner, in close to a thousand swimming pools protected by W. & T. sterilizers, the bathers are swimming in water fit to drink.

The almost universal use of W. & T. apparatus and liquid chlorine to sterilize public water supplies and swimming pool water has brought about Wallace & Tiernan's country-wide organization of trained public health engineers, each thoroughly conversant with all problems of water purification and each available to coöperate without charge with architects, engineers and owners interested in swimming pool sanitation.

Hundreds of the leading Schools and Universities in North America are using W. & T. swimming pool sterilizers.



THE SWIMMING POOL AT COLUMBIA HIGH SCHOOL, SOUTH ORANGE, MAPLEWOOD, NEW JERSEY, IS EQUIPPED WITH A W. & T. STERILIZER

Wallace & Tiernan manufacture a complete line of Swimming Pool and Water Supply Sterilizing Equipment. We will be glad to send detailed information to any address upon request.

AMERICAN AIRDRY CORPORATION

2587 E. Grand Blvd., DETROIT, MICHIGAN

"The Electric Towel"

Leading schools and colleges throughout the United States practice hygiene where it is taught by using the "Electric Towel."

The improved "Electric Towel," a development of ten years by the originators of electric hand drying, is offered in new and attractive models for both hand drying and hair drying in school lavatories and swimming pool dressing rooms.

The "Electric Towel" eliminates the necessity of cloth or paper towels, and cuts expenses in half. It dries in a most natural and pleasant way, diffusing a blend of heat and air in the correct proportions over the hands, face or hair, and leaves the skin fresh, invigorated and thoroughly dry. Because the drying is accomplished by evaporating the moisture, chapping of the skin is impossible.

Equipped with an especially designed "G. E." electric motor, the "Electric Towel" operates so quietly and quickly that except for the sensation of clean, warm air being blown against the skin, the user is scarcely aware of its mechanical action. No noise, no vibration and thorough drying —the results of continuous improvement in the manufacture of this machine.

The economy of the "Electric Towel" as compared with cloth or paper towels and the atmosphere of cleanliness and good order that it imparts to the wash room are factors which make it a popular addition to the school lavatory. No unsightly heaps of discarded towels with their attendant fire hazard, and a saving of from 60 to 80 per cent in wash room maintenance!

The built-in "Electric Towel" with adjustable nozzle is specified by progressive school architects and school superintendents everywhere as standard wash room equipment. Another popular model is the standard pedestal type which is most generally in use where original installations have not been made. It is equipped with foot pedal control and adjustable nozzle, making it available for either hand or hair drying. Finished in pure white porcelain enamel, it is an attractive addition to any wash room.

Send today for illustrated booklet and list of schools and colleges where the "Electric Towel" has been in use for several years.

STANDARD PEDESTAL TYPE

WASH ROOM EQUIPPED WITH RECESSED WALL TYPE

AMERICAN TAR PRODUCTS COMPANY

General Offices: PITTSBURGH, PA.

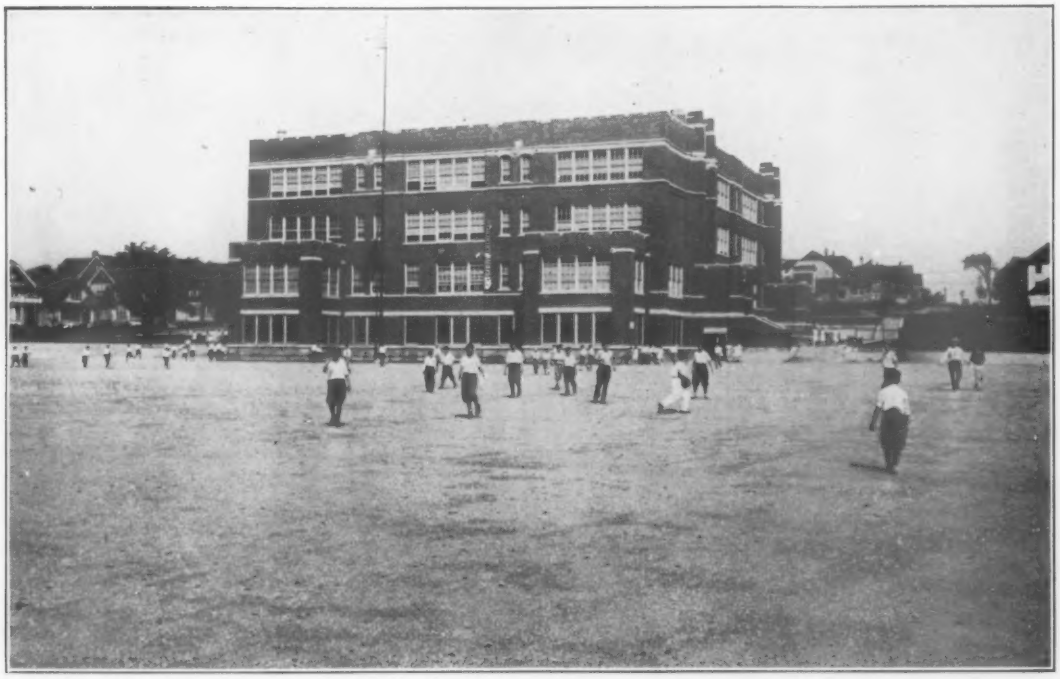
New England Division: TAR PRODUCTS CORPORATION, Providence, R. I.

PLANTS

Chicago, Ill.	Utica, N. Y.	Hartford, Conn.	Follansbee, W. Va.
Milwaukee, Wis.	Lowell, Mass.	Providence, R. I.	Jersey City, N. J.
Youngstown, Ohio	Birmingham, Ala.	New Haven, Conn.	St. Louis, Mo.

Tarmac

Makes Good Playgrounds



The playground pictured above is built to the specifications adopted as standard by the City of Milwaukee.

This construction provides a clean, healthful surface on which to play. Its sanitary, waterproof nature prevents absorption and results in quick drying. It is smooth; and its resilient surface is less tiring than a rigid one. It is never slippery.

This Tarmac surface is built up over a base of cinders, gravel, slag, or stone. It consists of a two-inch wearing surface of crushed stone or slag, penetrated and sealed with Tarmac. It is finished off with a top dressing of sand. Clean—healthful—long lasting—low in cost.

Specifications which describe in detail each step of construction will be sent you on request.

MITCHELL MANUFACTURING COMPANY

Manufacturers of

"Betterbilt" Playground Apparatus

1401—29TH AVENUE, MILWAUKEE, WIS.

DISTRICT REPRESENTATIVES

St. Paul—Cleveland—Des Moines—Dallas—Chicago—Wichita

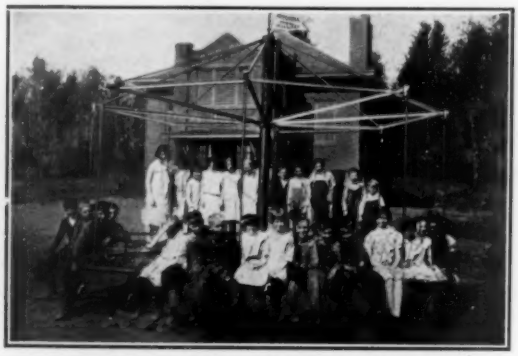
SCHOOL PLAYGROUND, WEST ALLIS, MILWAUKEE, WIS.

MITCHELL EQUIPMENT IDEAL FOR SCHOOLS

Mitchell Playground Equipment is designed to accommodate the largest number of children consistent with safety and to give them as great a variety of exercise and pleasure as it is possible for human ingenuity to conceive. Where playgrounds must serve a great number of children of all ages, Mitchell Equipment will be found best, as the apparatus may be had for every recreational purpose and in an almost endless variety of combinations.

Into the manufacture of this equipment goes the best of materials and the most skilled construction. It lives up to its name, "Betterbilt," in every instance, and purchasers may feel assured that no better nor more economical apparatus for physical development can be had anywhere.

Whatever your recreational equipment problem, Mitchell Apparatus will solve it in an ideal way. Write us fully your local situation and we will advise you out of the wealth of our experience. There is no obligation to this advisory service. It is a pleasure to describe how well Mitchell Equipment is meeting every playground need, from the small neighborhood plot to the most extensive park layout.



A RURAL SCHOOL AT DEER PARK, WIS.

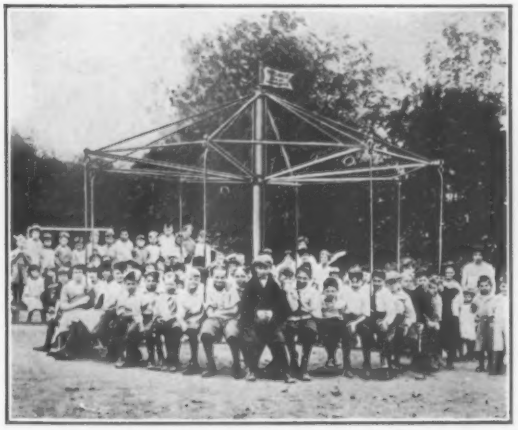
OAK GROVE SCHOOL, MILWAUKEE, WIS.

PARK PLAYGROUND, MILWAUKEE, WIS.

MITCHELL MERRY-WHIRL

The MITCHELL MERRY-WHIRL is very rapidly becoming the most popular piece of playground apparatus on the market. It is especially desirable because of its element of safety and moreover its exceptional facilities for the producing of healthful and invigorating exercise to the children. It is strongly built, very attractive and is designed so as to consume only a very small area of space.

One of its main features is that it has a capacity of fifty children which makes it the least expensive piece of playground apparatus per child that could possibly be placed on any playground. Because of its indestructible bearing members, the Merry-Whirl can be easily operated by a single child. The platform or endless seat revolves around a staunch steel mast and can be simultaneously swayed to and from the mast. The seat remains, at all times, parallel to the ground, and eliminates the dip motion.



50 CHILDREN ENJOYING THE MITCHELL MERRY-WHIRL

CATALOG AND SERVICE

Everyone interested in playground work should have a copy of the Mitchell "Betterbilt" catalog. With each catalog is offered Mitchell Service, a service which relieves everyone of the struggle with problems and details. Our engineers can answer on the basis of past experience, a service which places no one under obligation.

OUR GUARANTEE

We guarantee that the apparatus shown in our catalog is exactly as illustrated and described. We guarantee to give you full and complete satisfaction when you purchase apparatus from us; that equipment sold you represents full value, and will give you the satisfaction you have the right to expect. If for any reason goods purchased from us are not satisfactory, same can be returned to us at our expense and can either be exchanged for something else or money refunded.

Don't fail to write for our catalog, which fully describes "Betterbilt" playground apparatus

SUGGESTED COMMUNITY PLAYGROUND

NARRAGANSETT MACHINE COMPANY

Manufacturers of

GYMNASIUM APPARATUS, STEEL LOCKERS, SHELVING,
STORAGE CABINETS, PLAYGROUND APPARATUS

General Office and Works:
Pawtucket, R. I.

Mailing Address:
P. O. Box 1454, Providence, R. I.

Branch Offices:
New York, 214 East 40th Street
Chicago, 1504 Monadnock Block

GYMNASIUM APPARATUS

For more than 45 years Narragansett Gymnasium Apparatus has faithfully served Physical Education in schools, colleges, and institutions. What probably is the largest reserve gymnasium apparatus stock in the country is maintained in the store room to supply your requirements. Much of the equipment must be made special to fit your particular gymnasium. Our policy has always been to serve the institution direct, thus giving factory service where the various engineering details are involved. Our engineering department will gladly make recommendations as to the best type of apparatus for your definite problems.

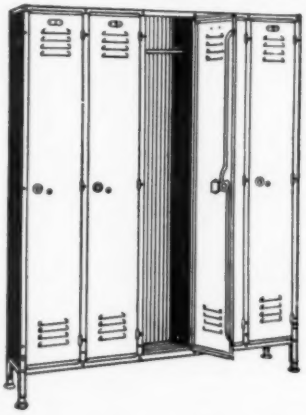
GYMNASIUM CATALOG F

The Narragansett Gymnasium Catalog fully illustrated is used as a standard for specifications. Bound in the latter half of the catalog is our Manual of Gymnasium Construction. This is also furnished in monograph form for architects and building committees. Full detailed information is given regarding the gymnasium building, particularly the preparation of walls and ceiling for attached apparatus.

ANTHROPOMETRIC APPARATUS

We manufacture anthropometric apparatus that is used by physicians and physical directors for ascertaining the physical measurements of the individuals. A large stock is kept on hand for prompt shipment.

STEEL LOCKERS



As one of the pioneers in steel locker manufacture, the Narragansett Standard Lockers have given satisfaction as to service, attractiveness, and durability. They are made in a variety of sizes and combinations. Prompt shipment is made from stock. Full information is given in Catalog G.

STEEL SHELVING AND STORAGE CABINETS

For offices, stock rooms, laundries, sewing rooms, and check rooms Narragansett Adjustable Steel shelving is economical, fire-resisting, and durable. Estimates are furnished. Ask for Shelving Folder.

Steel Storage Cabinets for office supplies, books, tools, records, etc., can be furnished in various sizes from stock. Attractive factory prices are given in the Cabinet Folder.

PLAYGROUND APPARATUS

Narragansett Playground Apparatus is designed for safety, sturdiness, and long life. Swings, seesaws, slides, giant strides, etc., are shown in the Playground Catalog D.

A NEW INVENTION—THE STANFORD "WATER WAGON"

THE ATHLETIC FIELD NECESSITY

Every athletic official of university, college, and school will welcome the opportunity to secure a Stanford "Water Wagon" and banish from the field the **common** water bucket, dipper, sponge, and towel in training and competition. Also, the individual cups, with the nuisance of spilling half their contents, and blowing about the field, are doomed to be displaced.

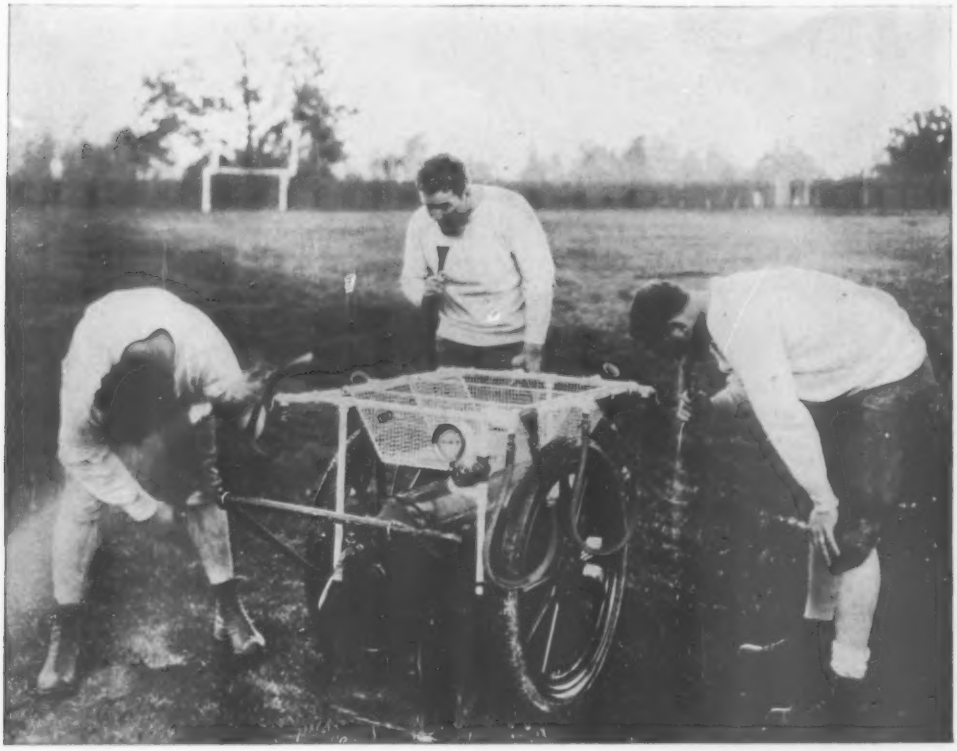
Free from Infection

Coaches and physicians in charge of athletic teams recognize the occurrence of throat, respiratory, and skin affections that on occasion run through the greater part of the squad. Now the educational institutions have the opportunity to raise their hygienic standards to those of practically every city health department in the country.

Efficient Field Supply Cart

The Stanford "Water Wagon" consists of a water tank on two automobile wheels. Compressed air forces the water through the eight outlets on the two sides and front of the wagon. Each outlet is supplied with a flexible hose about two feet long, ending with a bell-shaped faucet that is controlled by a spring valve. This valve is easily gripped and on pressing the valve, with the hand, a spray of pure water is released that may serve as a drink, mouth wash, gargle, face wash, or shower. The cart carries a basket in which may be placed a number of small towels for individual service, and the physician's or trainer's kit for first aid service.

Originated at Stanford University, California, the "Water Wagons" were a great success in the Fall of 1927 on their Athletic Fields. West Point is now equipped with the Stanford "Water Wagon." Write at once for literature, and get the full benefit of this hygienic service this Fall.



ROBERTS FILTER MANUFACTURING CO.

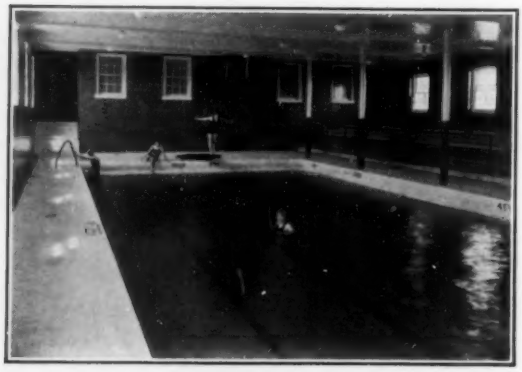
607 Columbia Avenue

DARBY, PENNA.

SWIMMING POOL SANITATION

Recirculation has completely solved the question of swimming pool sanitation. It is mandatory under State Board of Health regulations in many states. With recirculation the water is drawn from the deep end of the pool by a centrifugal pump and returned through filters and sterilizing equipment and in the case of indoor pools, through a heater to the shallow end of the pool.

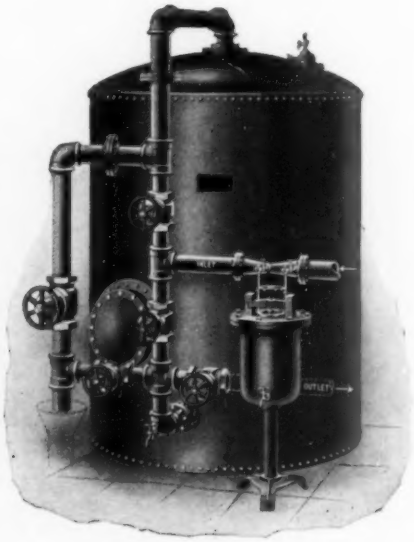
Our new Swimming Pool Catalog, copy of which will be mailed on request, contains a typical arrangement of pressure filters in conjunction with a recirculating system for indoor pools.



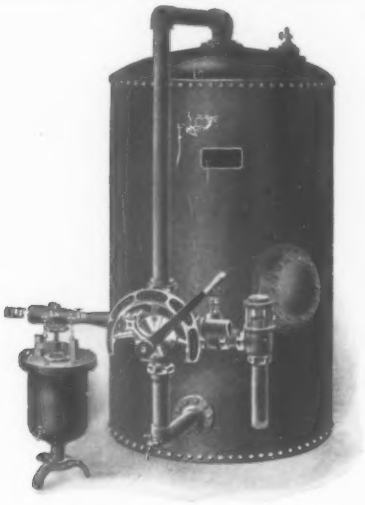
STATE TEACHERS COLLEGE,
HARRISONBURG, VA.

DESIGN

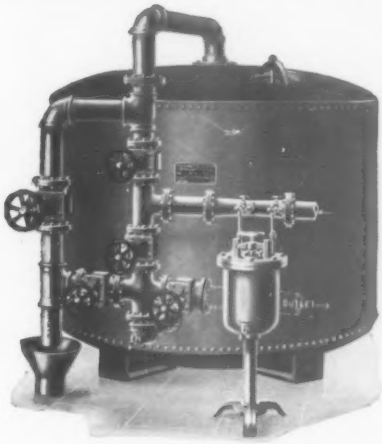
Where the bathing load is normal, the recirculating plant for pools of not more than 100,000 gallons capacity should be designed to recirculate the entire capacity of the pool in 8 hours. For pools containing greater capacity, a recirculating period of 12 hours can be employed. The rate of filtration should preferably be 3 gallons per square foot of filtering area per minute but in no case should it exceed 4 gallons per minute per square foot. Over 400 swimming pools all over the country are now employing Roberts Filters with distinct success.



STYLE "H"



STYLE "G"



STYLE "L"

COOPERATION

Our Engineering Department is at the service of Architects and Engineers engaged in the design, construction or maintenance of swimming pools. We welcome every opportunity of cooperation. Our new Swimming Pool Catalog mentioned before contains complete data on the sanitation of swimming pools.

EQUIPMENT

All filters are fully equipped and before shipment are assembled and carefully tested. With each installation we include an automatic coagulant device.

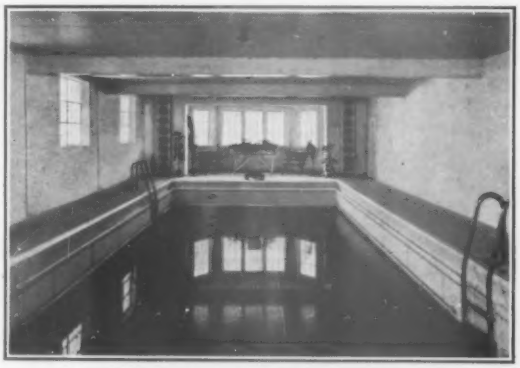
Cleaning of Roberts Filters is thoroughly and easily accomplished by reversing the flow of water, which lifts and "liquefies" the sand bed, scouring it on itself and flushing the accumulated suspended matter and impurities to the sewer.

SPECIFICATIONS

Specification data on all types of Roberts Filters in bulletin form will be sent on application. Our styles "H," "G," "L" and horizontal pressure filters are recommended for swimming pool recirculation.

ACCESSORIES

We manufacture pool fittings, haircatchers and other accessories which will be supplied separate from filters and other recirculating equipment when specified or so ordered.



ALMA COLLEGE, ST. THOMAS, ONTARIO, CANADA

THE STEWART IRON WORKS COMPANY

INCORPORATED

Iron Fence, Chainlink Wire Fence and Ornamental Iron and Wirework

428 Stewart Block, CINCINNATI, OHIO

PRODUCTS

Arches for Gateways
Area Gratings
Balcony Railing
Basement Window Guards
Bracket Lanterns
Bridge Railing
Cashier's Cages
Cashier's Wickets
Cellar Doors
Chainlink Wire Fence
Coal Chute Doors
Counter Railings
Folding Gates
Fireproof Safes
Grilles
Gates for Stores, Banks and Offices
Iron Fence
Iron Reservoir Flower Vases
Jail and Prison Work
Lamp Standards
Lawn and Garden Fountains
Motor Truck Bodies
Porch Railing
Public Drinking Fountains
Settees and Chairs (Iron and Wire)
Stair Railing
Steel Shutters and Doors
Sidewalk Gratings
Vault Doors
Window Guards (Iron and Wire)
Wire Counter Railing
Wire Partition Railing
Wire Fence (Chainlink)

FACILITIES

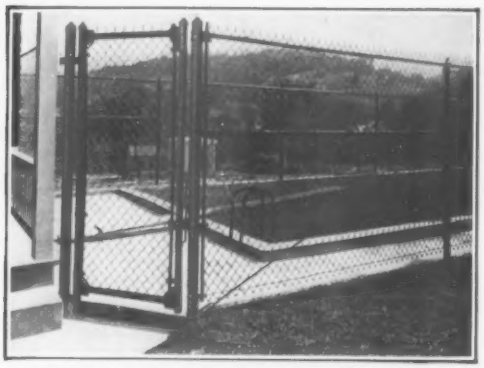
This company, "The World's Greatest Iron Fence Builders," has unsurpassed facilities for the manufacture of any of the products listed above. These facilities comprise a factory containing 350,000 sq. ft. of floor space and covering 8 acres; an equipment of modern machinery; skilled workmen and a complete organization of engineers and draftsmen. This, together with over 40 years of practical experience in this line, insures the highest standard of work, prompt service and reasonable prices.

IRON FENCES AND GATES

This company specializes in the building of high grade plain and ornamental wrought iron fences and gates, light or heavy, for schools, playgrounds, parks, etc. They are constructed either from designs of its own draftsmen or from drawings and specifications submitted by customers. From its experience, the company is qualified to advise as to the type of fence best adapted to particular conditions and to aid in the most satisfactory and economical solution of fencing problems.

For the front approach and lawns of the well-planned school premises nothing can take the place of a high-grade, well-designed Wrought Iron Fence. Such a fence can be erected to any reasonable height, and will be as nearly non-climbable as a fence can be made. A wide variety of tasteful designs are available which create that atmosphere of dignity and permanence which should always be inseparable from any public institution.

THERE IS SUBSTANTIAL BEAUTY IN STEWART WROUGHT IRON FENCE AND GATES FOR SCHOOL FRONTAGES



STEWART CHAINLINK FENCE EXCLUDES INTRUDERS FROM THIS SCHOOL SWIMMING POOL

CHAINLINK WIRE FENCE

For the playground, Wrought Iron Fence is also preferred if the grounds have a street frontage. If not, or if available funds are limited, Stewart Chainlink Fence will serve the purpose admirably. It can be supplied in various heights to suit any and all purposes where protection and durability are the principal requirements, such as for athletic fields, swimming pools, tennis courts, baseball backstops, etc.

THIS PLAYGROUND IS AMPLY PROTECTED BY STEWART NON-CLIMBABLE CHAINLINK FENCE

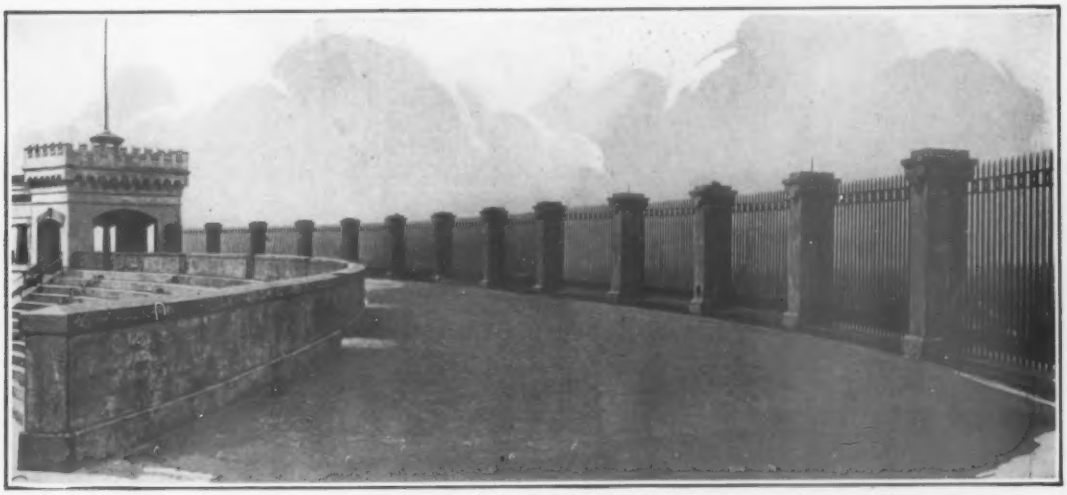
STEWART CHAINLINK FABRIC

Woven of No. 6, No. 9 or No. 11 gauge, copper-bearing steel wire, hot dip galvanized after weaving. This fabric has a galvanized coating which actually weighs between eight and nine per cent of the finished product, and the coating is approximately five times heavier than that of the regular grade of galvanized wire.

STEWART CONSTRUCTION AT CORNERS AND GATES MAKES AN EXCEPTIONALLY SUBSTANTIAL STRUCTURE

This company is prepared to study your requirements and will be glad to submit special designs or ideas in connection with any proposition that may be under consideration.

Complete catalogs of Stewart Wrought Iron Fence and Chainlink Fence are available and on request the special School and Playground Fence Bulletin will be sent.

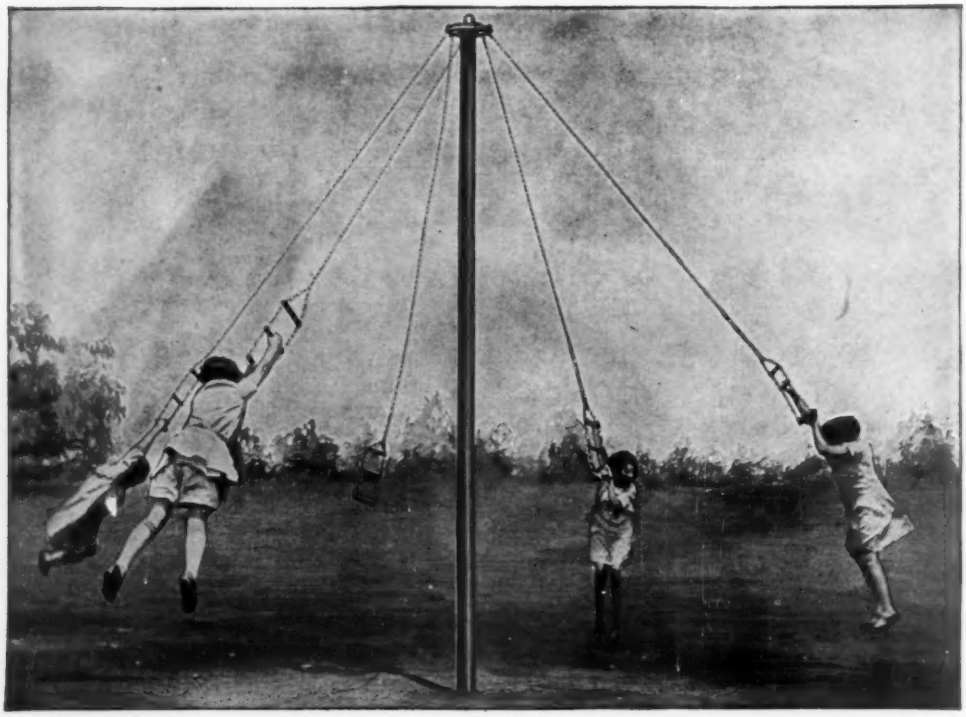


STEWART WROUGHT IRON FENCE GIVES DIGNITY AND BEAUTY, AS WELL AS PROTECTION, TO THIS ATHLETIC STADIUM

AMERICAN PLAYGROUND DEVICE CO.

Playground and Water Sport Devices

ANDERSON, INDIANA



Separate catalogs for Playground Devices and Pool Equipment; either or both furnished immediately upon request.

SWINGS

with pipe frames designed to minimize the cost of this part of the equipment. Our eight-swing unit can be purchased complete with all pipe for practically the same cost as the old-style six-swing unit.

WHY PAY MORE FOR PIPE?

QUALITY of our products is second to none.

A complete line of outdoor playground equipment, swimming pool and water sport devices.

SLIDES

having bottoms of rustless and stainless steel that is not affected by fruit acid or even salt water. Two sizes are made in the ALL-METAL construction, in connection with which not a particle of wood is used; all parts hot-galvanized; practically unlimited life.

SHIPPING SERVICE positively unequalled.

THE AMERICAN SCHOOL AND UNIVERSITY

ARMCO CULVERT MFRS. ASSOCIATION

MIDDLETOWN, OHIO

ARMCO *perforated* PIPE

INSTALLING ARMCO PERFORATED PIPE UNDER ATHLETIC FIELD AT ASHEVILLE, N. C.

SAFEGUARD YOUR PLAYING FIELDS WITH DEPENDABLE DRAINAGE

School prestige and income depend on athletic activities. Proper drainage of the playing field, therefore, is of greatest importance, so that practice or games can proceed as per schedule without interference by the elements.

Many schools have found in Armco Perforated Iron Pipe the solution to their drainage problems. Strong, durable, efficient, this sturdy product can be depended on to render satisfactory service for many successful years.

As topographical and soil conditions are never exactly the same, experience in difficult drainage problems is an essential to an economical first plan for your field. The experience gained by Armco engineers through more than 22 years' contact with drainage problems is yours for the asking.

© 1928, Armco Culvert Mfrs. Assn., Middletown, Ohio.

THE EVERWEAR MANUFACTURING CO.

37 SYCAMORE STREET, SPRINGFIELD, OHIO

Represented by School Supply Distributors and Others of Standing

EverWear Playground Apparatus
EverWear Water Apparatus
EverWear Junior Playground Apparatus

161 different types and sizes of playground apparatus are found in the standard EverWear line and 28 in the EverWear Junior line.

EverWear is noted for its safety, durability, beauty, and playability. Investigating and testing are invited.

A splendid record of 21 years' service to the youths of the world is back of each EverWear outfit.

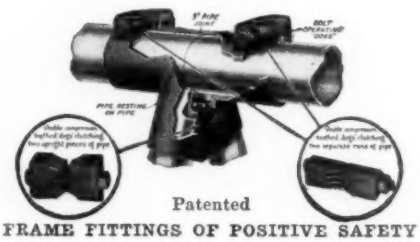
EverWear is sold on a positive guarantee of satisfaction, or money refunded.

Keep the playgrounds open for 12 months of every year and save lives.

Stop the terrible toll of child traffic accident and fatality by building and properly equipping playgrounds.

Indicate your preference, and we shall gladly send catalog and prices, or have a Representative call.

Your obligation is to secure the best. Users say EverWear fills this requirement.



Patented
FRAME FITTINGS OF POSITIVE SAFETY

SLIDES OF ALL TYPES AND SIZES

40 AND MORE CHILDREN AT ONE TIME

SWINGS OF ALL APPROVED TYPES AND SIZES, EQUIPPED WITH THE EVERWEAR PATENTED FITTINGS

GRAVER CORPORATION

Swimming Pool Purification Equipment
Water Softeners—Filters—Steel Tanks
4250 Tod Avenue, EAST CHICAGO, INDIANA

SANITARY SWIMMING POOLS

No modern recreational program is complete without proper swimming facilities. Swimming is a healthful recreation in a sanitary pool.

Any swimming pool can be kept clean and sanitary. It is not just a matter of changing the water at certain intervals and scrubbing the sides and bottom. A properly built sanitary pool may be filled with water at the beginning of the term in September and not emptied until June and always be clean and the water as pure as drinking water.

With the knowledge and the equipment of today it is unnecessary to allow a pool to operate in the dangerous, unhygienic, expensive method of former years.

GRAVER POOL EQUIPMENT

This equipment consists of a complete system of pumps, motors, filters, heater and sterilizer.

The water is taken from the pool forced through the filters, heater, sterilizer and returned to the pool. All dirt is removed from the water, it is heated to a predetermined temperature, and sterilized, killing all bacteria. The capacity of the system varies with the size and popularity of the pool. As a rule the system is designed to handle the entire contents of the pool in 10 to 12 hours. With this system the only water necessary to add to the pool is to replace that which evaporates, is splashed from the pool and carried out by the bathers.

GRAVER FILTERS

The heart of this system is proper filtration. Graver filters have been used with universal success with all kinds of water for many years. One big reason for their success is the strainer plate method of supporting the filter bed which does away with clogging and inactivating certain areas in the filter bed. This strainer plate also secures thorough distribution of the backwash water.

GRAVER SERVICE

Our experience covers many pools, operating in every possible manner. Nearly every pool has some "out-of-the-ordinary" circumstance. We feel we can help you, especially so in these cases and will appreciate you bringing your problems to us.

We know that our Bulletin No. 500, "The Water Supply for Swimming Pools," will interest you. Write for it.

GRAVER WATER SOFTENERS

In cases where you have a hard water, a Graver Water Softener will give definite tangible savings in your power plant. Write for particulars.

POOL AND GRAVER EQUIPMENT, OHIO UNIVERSITY, ATHENS, OHIO

NORWOOD ENGINEERING CO.

Filters for Natatoriums

FLORENCE, MASS.

NORWOOD NATATORIUM FILTERS

Many swimming pools throughout the country in schools, colleges, Y. M. C. A.'s and community buildings are today being kept wholesome, clean, invigorating and safe at a nominal cost with the Norwood three-unit filtration system.

While we manufacture single and double unit systems, experience has taught us that the three-unit system is far superior and more economical. Its advantages are enumerated in our booklet, "Filters for Natatoriums," a copy of which will be gladly sent upon request.

HEARTILY COMMENDED BY SCHOOL HEADS

Christian College, Columbia, Mo.

It gives me pleasure to state that the triple filters of the Norwood Engineering Company of Florence, Mass., in our natatorium have proved entirely satisfactory. We averaged last summer an attendance of 125 people daily in the use of our pool, and have had no trouble of any kind in connection with its use. I would **heartily commend** the use of these filters to anyone contemplating the construction of an up-to-date natatorium.

MRS. L. W. ST. CLAIR-MOSS,
President.

Virginia Intermont College, Bristol, Va.

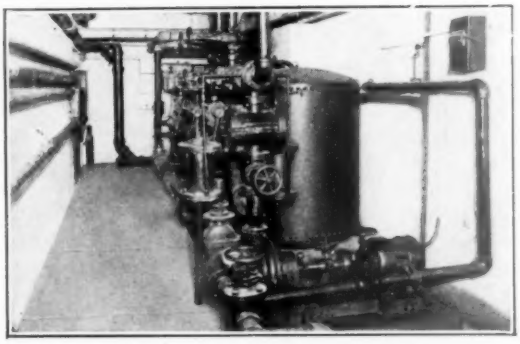
The filter plant installed two or three years ago in connection with the swimming pool of Virginia Intermont College is giving entire satisfaction.

H. G. NOFFSINGER,
President.

Worcester Academy, Worcester, Mass.

The filter installed by the Norwood Engineering Company has been satisfactory and done its work splendidly.

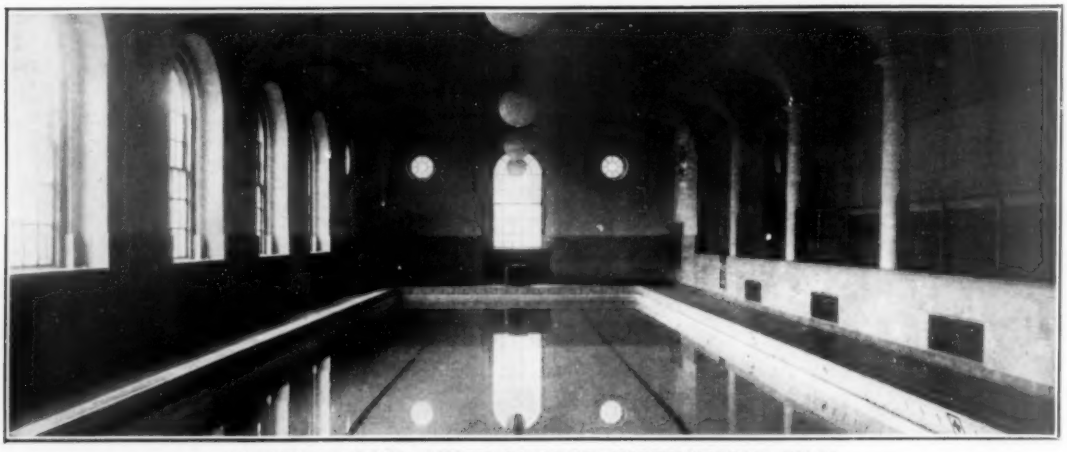
R. J. DELEHANTY,
Director of Physical Training.



3 60" FILTERS USED IN CONNECTION WITH SMITH COLLEGE SWIMMING POOL

OTHER COLLEGES AND SCHOOLS USING NORWOOD FILTERS

Amherst College, Amherst, Mass.
Dartmouth College, Hanover, N. H.
Hamline University, St. Paul, Minn.
International Y. M. C. A. College, Springfield, Mass.
Yale University, New Haven, Conn.
Bristol High School, Bristol, Conn.
George Peabody School, Nashville, Tenn.
Holyoke High School, Holyoke, Mass.
Dwight St. High School, Holyoke, Mass.
Hotchkiss School, Lakeville, Conn.
State Normal School, Emporia, Kans.
Nolan School, Fitchburg, Mass.
Middlesex School, Concord, Mass.
Mount Ida School, Newton, Mass.
New Sullins College, Bristol, Va.
Pasadena Military Academy, Pasadent, Calif.
Phillips Academy, Andover, Mass.
Mumford St., Seventh Ave. and Willett St. Schools, Schenectady, N. Y.
State Normal School, Spearfish, S. D.
Ward-Belmont School, Nashville, Tenn.
Wethersfield Ave. School, Hartford, Conn.



SWIMMING POOL, SMITH COLLEGE, NORTHAMPTON, MASS.

FRED MEDART MANUFACTURING CO.

Manufacturers of

Steel Lockers, Steel Shelving, Steel Cabinets, Gymnasium Apparatus
Playground Apparatus and Swimming Pool Equipment

General Office and Works: 3550 DeKalb St., ST. LOUIS, MO.

BRANCH OFFICES IN PRINCIPAL CITIES

PRODUCTS

Steel Lockers; Steel Shelving; Steel Cabinets; Gymnasium Apparatus; Swimming Pool Equipment; Playground Apparatus.

MEDART STEEL LOCKERS

Medart steel lockers, like Medart gymnasium apparatus, embody the highest standard of workmanship and materials. They represent the latest advance in design and method of construction. There is no other way of assuring such low cost per year of service. It is generally recognized that a Medart locker installation represents an investment in unqualified satisfaction.

Let us assist in planning your locker installation. There is no obligation involved. Just send us the details of the locker problems with which you are confronted and our engineering department will offer suggestions which will aid you in solving your problems.

Our locker catalog, A-11, fully illustrates all sizes and types of Medart lockers, and describes their construction and installation. Write for a copy to-day.

MEDART STEEL SHELVING

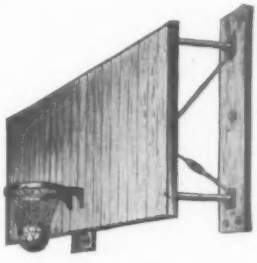
Medart steel shelving is made up of standardized units which can be assembled in an unlimited variety of storage racks. Write for the Medart Steel Shelving Catalog S-3.

MEDART STEEL CABINETS AND WARDROBES

There are thirteen sizes and combinations of Medart cabinets and wardrobes which can be furnished in olive green, french gray, white, grained mahogany or grained walnut. Catalog C-8 illustrates and describes this line.

MEDART GYMNASIUM APPARATUS AND SWIMMING POOL EQUIPMENT

Fifty-five years of extensive experience is embodied in each piece of Medart gymnasium apparatus and swimming pool equipment.



The Medart gymnasium catalog should be in the hands of everyone interested in gymnasiums and swimming pools — their equipment and use. It not only illustrates and describes every recognized type of gymnasium apparatus and swimming pool equipment, but it also discusses in detail the planning and equipping of gymnasiums and swimming pools. Write for a copy of Catalog L-4.

MEDART PLAYGROUND APPARATUS

The factors of Safety, Service and Durability have determined the design and construction of each piece of Medart playground apparatus.

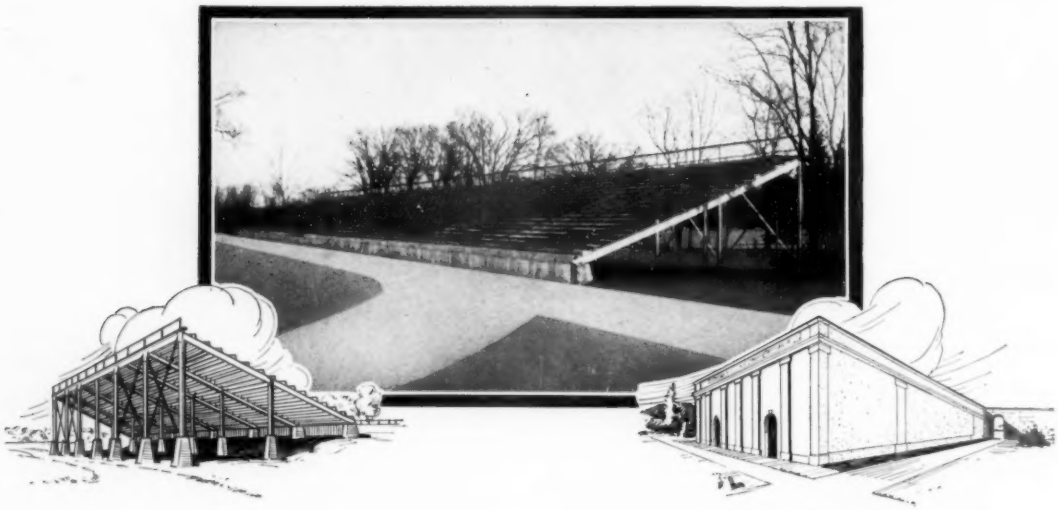
Everyone interested in playground work should have a copy of the Medart Playground Apparatus Catalog M-4. In it you will find over thirty pieces of playground apparatus illustrated, described and priced —send for a copy to-day.

Safety, Service and Durability

PITTSBURGH-DES MOINES STEEL COMPANY

1053 Professional Bldg., Pittsburgh, Pa.
657 Hudson Terminal Bldg., New York City
955 Tuttle St., Des Moines, Ia.
3169 L. C. Smith Bldg., Seattle, Wash.
1263 First National Bank Bldg., Chicago, Ill.
367 Rialto Bldg., San Francisco, Calif.

Builders and Fabricators of the
Pittsburgh-Des Moines
ALL-STEEL GRANDSTAND



The Pittsburgh-Des Moines all-steel grandstand is so designed and built that it is directly adapted to athletic fields of universities, colleges and schools. This stand provides a maximum seating capacity for any available area at a minimum cost. It is an absolutely permanent structure and cannot possibly collapse. Steel will not burn or deteriorate under the action of the weather.

This steel stand is constructed of heavy interlocking steel plates formed into steps. All loads coming on these steps are carried to the ground by steel beam stringers and structural steel columns. The seats, which are of wood, are raised several inches off the steel steps and take no part in carrying the loads of the stand.

This steel grandstand has many advantages and outstanding features.

If desired, it can be architectually treated with little cost by building an outside wall of brick, concrete, or expanded metal with stucco around the two ends and back.

Upkeep is very small as an occasional coat of paint is all that is required.

The seams of the steel plates are water tight and dressing rooms, etc., can be easily and inexpensively built under the stand.

The investment value of the steel grandstand is high as it can be taken down and relocated anywhere.

The seating capacity can be easily and inexpensively increased by extending the stands at the ends or back or by building an upper deck.

This steel grandstand can be furnished and ready for use within a remarkably short time.

Many institutions have realized and taken advantage of these outstanding characteristics of the Pittsburgh-Des Moines all-steel grandstand.

Write for further information. It will be gladly furnished free of any obligation.

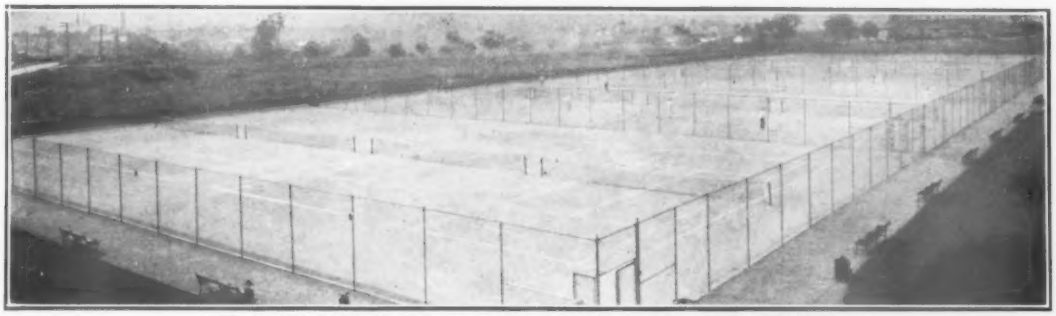
RUBIEN CONSTRUCTION COMPANY

ENGINEERS and CONTRACTORS; Specialists in School Athletic Fields
Municipal Playgrounds, Tennis Courts, Running Tracks, Handball Courts
858 Sixth Avenue, NEW YORK CITY Telephone: BRYant 10205

ILLUSTRATIONS OF OUR WORK

OPENING WEEQUAHIC PARK, NEWARK, N. J. QUARTER MILE RUNNING TRACK

LA SALLE MILITARY ACADEMY, OAKDALE, L. I. 12 HAND BALL COURTS SURROUNDED BY A BOARD RUNNING TRACK



20 CLAY COURTS AT BRANCH BROOK PARK, NEW JERSEY
FENCING BY ATLAS FENCE CO.

LA SALLE MILITARY ACADEMY, OAKDALE. L. I. FOOTBALL FIELD, IRON GOAL POSTS

YANKEE STADIUM TRACK, NEW YORK CITY
AND
MACOMBS DAM PARK TRACK, NEW YORK CITY

PORT WASHINGTON, NEW YORK. HIGH SCHOOL QUARTER MILE TRACK

Section IV

CLASSROOM, OFFICE, LIBRARY AND AUDITORIUM

School Posture and Seating

BY HENRY EASTMAN BENNETT, PH.D.

FORMERLY HEAD OF DEPARTMENT OF EDUCATION, WILLIAM AND MARY COLLEGE

The Situation

IN mechanical construction, materials and finish, the better seating equipment in American schools has attained a high degree of excellence. Steel frames finished in black or dark green enamel with maple, birch or ply-wood surfaces lacquered over a soft brown stain, are the standard. In sanitary character, appearance and durability, such furniture leaves little room for improvement. In respect to educational and hygienic requirements, progress has been less satisfactory. The one definite educational demand in regard to seating has been for greater flexibility, but in the methods of attaining this desirable objective there has been little professional agreement and a too common tendency to follow enthusiasms rather than practical postural, visual and instructional requirements. Posture studies and teaching have been mostly confined to problems of the standing position, while posture habits and their tremendous significance in development, health and efficiency are mainly related to sitting. As a result, there is general ignorance of principles of seating as related to posture, and common practice in the construction and use of school seats violates the most basic of these principles. Lacking clear-cut ideals, manufacturers have commonly sought business through mechanical improvements, price competition, and occasional radical designs making claims of hygienic superiority which have little basis in knowledge or fact. The price appeal has been the most effective with school boards; in seating equipment which involves a relatively trivial expenditure but enters far more intimately into the welfare of the children, a policy approaching niggardliness has often prevailed.

The Seating Problem

The primary requirement of school seating is that it shall foster habits of erect sitting, and to that end it must be so designed and proportioned relative to the pupil's anatomy and to his occupations that he will sit erect at his work more comfortably than in any other position. It should permit complete freedom of movement, yet afford seat and back supports such that when trunk and shoulder muscles are relaxed he will remain erect with no disagreeable areas or ridges of pressure. The foregoing is a simple standard for an hygienic seat, and despite the free use of such terms as "hygienic" or "correct posture," no seat should be regarded as deserving the designation unless it meets this simple test. If, when any pupil sits in it and relaxes, there is a tendency to slide down in the seat or to sag at the waist into a stooped position, or if there is any definite pressure making the erect position disagreeable, it is not a "correct posture" seat.

So long as upholstery is not regarded as practicable in school seating, the forms favorable to good posture and the elimination of objectionable pressures must be worked out in unyielding wood. Designs must be suited to children of all ages and sizes and for surprisingly wide variations in the segmental proportions and normal forms of those of the same size. They must be adapted to varying sedentary occupations, disciplinary ideals and methods, school organizations, space limitations, book storage requirements and other factors, foreseen or unforeseen. There is, however, no conflict between legitimate educational and hygienic requirements, and good seating must be in harmony with both.

Seat Height

Correct height from the floor has long been recognized as a first requirement of seat hygiene. The only essential standard of correct height is that when the pupil is seated with feet squarely on the floor, there be *no pressure* under the knees or from the forward edge of the seat. If the seat is reasonably well shaped and sloped, it may be two or three inches lower than this limiting standard without objection and often with some advantage in the greater freedom of foot movement which the low seat permits. Discomforts, physical injury and postural objections arise almost exclusively from seats that are too high; yet more

FIGURE 1

Photograph of twelve-year old girl in ideal posture. The white string on the seat shows the position of the seat-bones. A chalk mark indicates the apex of the hip. Note how the buttocks extend behind the seat-back.

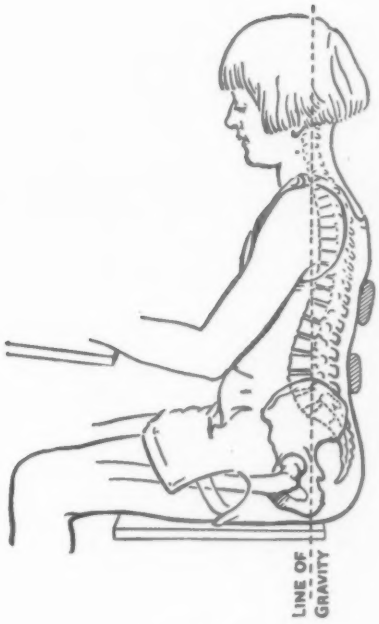


FIGURE 2

This sketch shows the position of the skeleton in the posture shown in Figure 1.

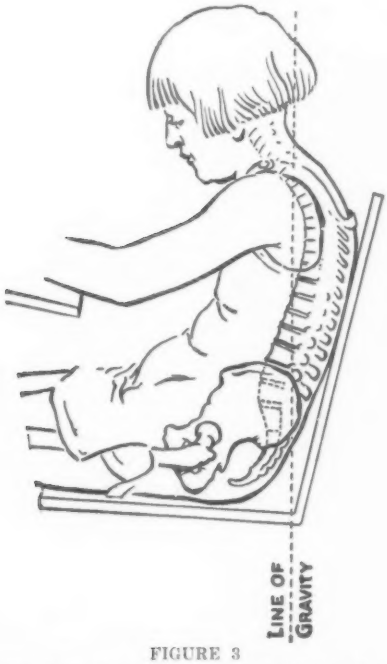


FIGURE 3

This sketch shows the position of the skeleton in the posture shown in Figure 4.

FIGURE 4

This picture shows the inevitable posture when child seeks to make use of a chair-back of this shape. The pelvis is tilted back and shoved away from the back of the chair, the lumbar curve of the spine is reversed, and the thorax and abdomen are compressed.

than half of the pupils in American schools are so seated, many thousands unable to touch the floor with their heels, but very few being on seats too low. School seats are regularly sold in adjustable types or in about six non-adjustable sizes varying by intervals of one to one-and-a-half inches. Yet thousands of classrooms are equipped with non-adjustable seats of a single size or adjustable seats set at uniform height and never adjusted. In almost any class the children differ by some four to six inches in correct seat height. The most practical method of securing correct seating in respect to height is to have the seats assorted or adjusted in accordance with published tables of grade distribution of seat heights based on scientifically accurate measurements of many representative classes.* Pupils should then be required to select seats in which they can sit with feet squarely on the floor and no pressure under the knees. Their selections should be verified by the teacher. Owing to class variations, it may be desirable to make a few readjustments downward, seldom upward.

Sitting Posture

That posture in sitting which is most favorable to physical vigor and development, to the formation of desirable posture habits, to efficiency in sedentary work, and to lasting comfort, is an erect but relaxed position which may be described as follows: The body weight is borne upon the seat by the ischial tuberosities (seat bones) almost exclusively. The pelvis is in vertical position so that the iliac crests (points of the hips) are in a vertical plane passing through the ischials. When the pelvis is in this position, there is a more or less pronounced concavity of the spine at the height of the hips (lumbar level), the points of the shoulders (acromia) are in the same vertical plane as the hips and ischials, the shoulders fall back and down of their own weight and in so doing expand the thorax and lift up on the abdominal muscles. The weight is balanced about the spine, which thus functions as a true supporting column carrying the weight in perfect poise with no muscular tension or fatigue. The muscles of the back are short and in tonicity without tension. All the visceral organs rest upon their normal supports from beneath with full space for vigorous functioning and with no compressions or displacements. All these conditions are interdependent and follow by mechanical necessity upon the vertical position of the pelvis and complete relaxation of the muscles. They are not a series of distinct ideals of posture but inevitable and inseparable characteristics of erectness. If any one of them is present and the *muscles relaxed*, the others will accompany it.

On the other hand, if the pelvis is tilted backward, as in stooped or slumped position, the lumbar spinal concavity changes to a continuation of the dorsal convexity, shoulders droop forward, back muscles are elongated, chest compressed, abdominal muscles loose and wrinkled, and the visceral organs deprived of their normal supports are compressed and pushed down upon each other in a continuous pile from lungs to pelvic organs. If this stooped posture has become habitual, there is more or less permanent flattening of the lumber vertebrae on the forward side and of the cartilaginous pads between them, so that the body tends to fall into this position whenever the back muscles are relaxed. Thus, for one who has formed the habit of stooped posture, erect sitting involves a very definite and fatiguing contraction of the back muscles, but for one whose vertebrae have not been so misshapen and whose back muscles are not permanently elongated, it requires only relaxation with the weight poised upon the spine.

Seat and Back Form

The form and dimensions of seat and back should be such as will maintain the pelvis in erect position with no other pressures than gravity and without discomfort. The essential back support is at about the level of the hips or "in the small of the back." The precise height of the support is not so important as that its vertical curvature shall conform to the contour of the back of each individual at the level where it is in contact. Any edge or ridge of pressure is particularly to be avoided. Additional back support against or just below the shoulder blades is necessary to avoid dangerous strains or pressures at the lumbar level. Back support against the buttocks serves no purpose, since it is below the flexible portion of the spine, and so far as there is contact here at all it tends to prevent full support in the lumbar curve.

The depth, form and slope of the seat must be such that the sitter can and will sit well back in the seat and fully utilize the support provided by the back. Individuals requiring the same seat-height, and sitting fully erect, vary widely in the position of the seat bones (ischials) relatively to the lumbar back support, as well as in the distance of the angle under the knees from that support, and in the form of the back curve. There should be no elevation of the seat-bed at the rear of the sitting area and no scoop which will tend to prevent any individual from sitting as far back in the seat as his form may require. Such rearward elevation serves no useful supporting function for those who sit forward of it, and makes erect position almost impossible for those who should sit farther back. There should be no ridges or sharp elevation that will cause pressure just forward of the ischials. The seat must be short enough (front to back) and sufficiently rounded down at the front edge to enable any occupant to attain full lumbar back support without any interference or pressure from the front edge under the knees. Seat pressure should

* Such tables with extensive data and discussions on all the topics of this article and related problems, bibliography, etc., are contained in "School Posture and Seating," by Henry Eastman Bennett. Ginn & Co., 1928. 323 pp.

be only under the ischial bones and the thick portion of the thigh muscles. There should be sufficient slope to gently favor a backward and definitely check any forward sliding tendency.

Desk-Top

The ideal position of the desk-top for writing purposes is such that when the pupil sits erect with both arms in writing position the plane of the writing surface will coincide with that of the underside of the forearms. This ideal permits of various slopes, but, because of the visual distance and angle, a slope of fifteen to thirty degrees is important. The near edge of the desk should be within three to five inches of the body, while one's back is in contact with its lumbar support. The height of the near edge should increase with the slope and with the forward distance of the desk. Owing to wide variations in segmental dimensions among children, there is no constant relation between seat-height and correct desk-height. Hence desk-tops should be adjustable in height relative to the seats. When the desk-top is to be used as a book-rest for reading, it should hold the book at an angle of forty-five to sixty degrees from the horizontal, at about the height of the shoulders or chin, and at distances from the eyes varying with individuals and with the size of type.

Lighting and Visual Strain

Problems of posture and of visual strain are inseparable, and both are involved in the position of the desk-top. Writing or printed matter lying upon a flat surface presents a distorted image to the eye owing to the foreshortening of the characters on account of the acute angle at which they are seen. To obtain a clearer image, the pupil inevitably stoops over the desk, thereby sacrificing his erect poise and such back support as contributes to it, usually leaning upon an elbow with an unwholesome lateral twist of the spine and bringing his eyes so near the book as to involve a strain tending to myopia. Furthermore, in the standard classroom with window light on the left side and seats in rows parallel therewith, some thirty to fifty per cent of the pupils seated in the left-rear portion of the room constantly have direct light or glare from the left-front in their eyes as they work. This condition involves serious eye strain, besides causing the pupils to adjust themselves to it by stooping over their work. The difficulty is easily avoided by arranging the seats so as to have those on the left side turned away from the windows at an angle of fifteen to sixty degrees. This may be done by arranging them either in parallel diagonal lines, or side by side in arcs having a center near the right-front corner of the room, or in numerous variations of these plans. There is no reason for any pupil's being subjected to glare. When the light actually comes from the pupil's left-rear (instead of left-front), he automatically tends to sit well up and to bring his work into the best position the desk permits.

Types of Seating

Movable seating for classrooms is more than justified in that it avoids injury to the floors by countless screw holes, more thorough cleaning of floors is practicable, classes are readily shifted from room to room or the position of individuals within a room, changing sizes of classes are provided for, rooms are quickly adapted for varying class or extra-curricular activities, pupils may be grouped and instruction socialized in various ways, and varying present and future methods of instruction and discipline provided for. (School seats normally outlast many changes of teachers and teaching method.) But seating should be moved only for definite purposes and with full knowledge of the visual, postural and instructional problems involved. The relation of seat to desk is of paramount importance and the two should constitute and move together as one inseparable unit suited to the individual occupant. The use of loose chairs which must be moved back from a table whenever a pupil rises, involves a number of serious economic, disciplinary and hygienic objections except in kindergarten, first grade and certain special classes where reading and writing are not dominant activities. Fixed seating is usually preferable for lecture rooms in which classes change frequently and no variation in the use or purposes of the rooms is probable. Pedestal table-arm chairs provide the most compact seating for lecture rooms, but should not be used for continuous writing or study purposes. Tablet-arms should be low, and no arm rest which continuously elevates one elbow should be tolerated. A large proportion of pupils of all grades have not room between the knees and correct writing level for a deep book box, hence boxes should be as shallow as practicable or eliminated entirely, as in the study-top desks, if book storage at the desk is not imperative.

Combination desks (having seat attached to the desk behind) are still in most common use. Single-pedestal combination desks are more convenient for the cleaning of floors. Separate stationary desks and seats have the advantage of complete individualization. Chair-desks (having the desk-top suspended from a movable chair) are the older and more economical form of movable desks. The present trend in the best schools is toward a stable movable unit consisting of a hygienically formed swivel seat attached to a desk with lifting-lid box or boxless study-top style.

Dramatic Equipment in Schools and Colleges

BY MILTON SMITH

HEAD OF THE DEPARTMENT OF ENGLISH, HORACE MANN SCHOOL FOR BOYS; INSTRUCTOR IN ENGLISH AND SPEECH, TEACHERS COLLEGE, COLUMBIA UNIVERSITY

THE "school play" is a very ancient institution. The earliest English comedy, "Ralph Roister Doister," was written in 1540 by Nicholas Udall, the famous Headmaster of Eton, to be produced by his robustious young scholars; the first English farce, "Gammer Gurton's Needle," was the work of a mysterious "Mr. S., Master of Art," in 1552, and was, according to the title page of the first edition, "Played on Stage, not longe ago in Christes Colledge in Cambridge." Thus, many years before 1576, when the first professional theater was built in England, the schools were active in play production. The effect of this activity on the outburst of dramatic literature that glorifies the Elizabethan era is incalculable.

Here in the United States, the school play is likewise a very old and respectable institution. But, as the last ten or fifteen years have seen a remarkable revival on the professional stage, leading to a new development of theater arts, so has there been a corresponding expansion of the prevalence of the school play. Today it is almost universal. In some schools, the plays are little more than speech exercises; but in a growing number of schools they are ardent and ambitious strivings in which a play is truly conceived as a synthesis of many arts and crafts.

The Importance of Play Production in Schools

Play production is the most democratic of the arts. It requires and coordinates a multitude of activities—activities as diversified as directing, managing, designing, acting, writing, carpentry, painting, stage lighting, costuming, and so on. Correctly understood in this larger sense, it has its place, which may be a very important one, in any scheme of education. Not that the schools should turn out professional actors, or stage carpenters, or designers, any more than courses in English composition aim to turn out professional authors. The main purpose of play production in the schools is to make literature a live and vivid thing for the students, and to be a real laboratory for the other arts and sciences.

To make play production assume even a small part of its possible rôle in modern education, two things are needed. The first is trained teachers. Fortunately, these are growing more numerous every year. University courses and dramatic schools are more and more giving the correct kind of work for teachers of play production. The second requirement is adequate equipment. Unfortunately, little has so far been done in this respect. Splendid school buildings are built with auditoriums designed to be used for school dramatics, but totally unsuited for this purpose. These trained teachers are working under impossible handicaps. They are somewhat like the early teachers of the sciences, when sciences were first introduced into the curriculum. Possibly they are worse off, for if the early science teachers had no equipment, the early teachers of dramatic art have bad equipment, which makes it impossible to do the thing correctly. And the tragedy of the situation is that adequate auditoriums and stages could be built and maintained at less expense than those in and on which they are now obliged to work.

The Principles of Auditorium Construction

The principles that should govern the building of the auditorium itself are obvious and well understood, even though they are far from universally observed. In the first place, the acoustic properties demand consideration. While these cannot be always determined definitely in advance, it is safe to say that any auditorium having large blank spaces on facing walls will have bad acoustics. It is therefore necessary to see that large wall spaces are broken by windows, recesses, or other architectural features. If the auditorium is already built, curtains may be hung or the walls may be covered with some material that will deaden reflection. "Hair felt" is the material that has the greatest effect.[1] It is always possible to improve the acoustic properties of incorrectly built auditoriums, but planning in advance should make correction unnecessary.

Secondly, the lines of vision should be considered. In a good auditorium, it should be possible to see the entire stage from every seat. The theater name for lines of vision is "sight lines." On the floor plan of an auditorium they may be represented by two lines from each seat (Fig. 1), one to each side of the proscenium arch. If there is a balcony, it is especially important that its sight lines be considered, and elevation has to be kept in mind, as well as width. Recently, a new auditorium was built in a prominent university, containing 1,500 seats. The "stage" was placed in the middle of one of the long sides of the auditorium, so that only about one-third of the seats in the orchestra face the stage directly; there are several hundred seats on each side which face the blank walls on each side of the proscenium arch. The balcony is a masterpiece of stupidity.

[1] See W. C. Sabine: "Collected Papers on Acoustics" (Harvard University Press, Cambridge, Mass. 1922).

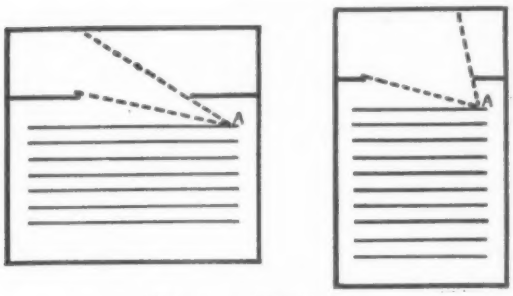


FIG. 1. SIGHT LINES

The auditorium shown on the left has bad sight lines. A person sitting at A can see less than one-half of the stage. The auditorium at the right is better.

Its pitch is so slight that the people in the second row can see the stage only by dodging around the heads of the people in the first row, and from beyond the third row the stage is visible only to standees. There are probably only 600 seats out of 1,500 from which the entire stage can be seen. Sight lines must not be disregarded.

Thirdly, hygienic conditions must be kept in mind. A good auditorium must be correctly ventilated and heated. There should be thought of the washroom and sanitary facilities. And the seats might just as well be comfortable as hard and deforming.

Lastly, the auditorium should make a pleasing esthetic appeal. It should be painted and decorated so as to be attractive. Its lighting should be soft and pleasant, not harsh and glaring. It should be the sort of room in which the audience will be in a frame of mind to enjoy a play, or whatever exercises are to take place there.

The Adequate and Suitable Stage

These obvious principles all deal with the auditorium itself. Less obvious, but even more important from the viewpoint of adequate dramatic work in the schools, is the necessity of a stage on which plays may be performed. The school theater, like all other theaters, is in reality merely a large room or building consisting of two main parts: (1) an auditorium for the accommodation of an audience; and (2) a stage to accommodate a performance. These two parts of the room are separated by a wall, in which there is an opening through which the audience may hear and see the performance. This opening is called the "proscenium" opening. The arch surrounding it is the proscenium arch. The opening may be closed at will by a curtain. It is with this space back of the proscenium wall that the rest of our discussion concerns itself.

The first consideration is naturally that of size. How large a space must be devoted to an adequate stage? This depends, of course, to some extent upon the size of the auditorium, but there are some minimum and maximum limits. The size of the proscenium opening is probably the first set of dimensions to be considered—that is, assuming that there is to be a proscenium wall and opening. It is ardently to be hoped that there is, and that no more schools will be built with

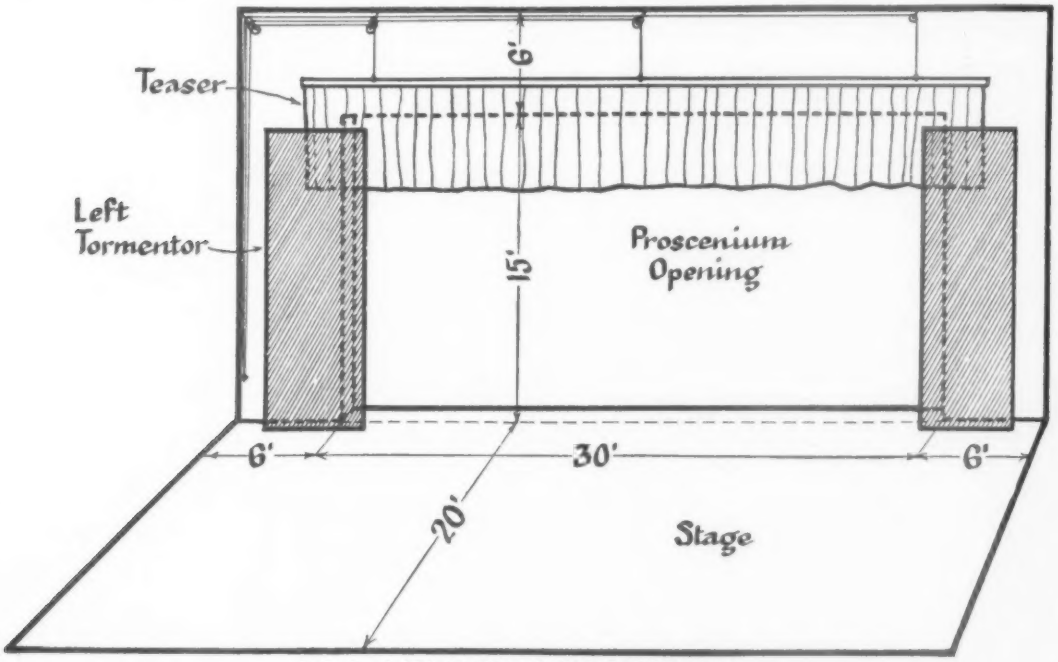


FIG. 2. A STAGE OF CORRECT PROPORTIONS

Notice the movable teaser and tormentors. This stage may be made any size by changing all the dimensions proportionally. More off-stage space would be useful, if the construction of the building would allow it; 10 or 12 feet might well be allowed at the top and sides of the proscenium opening instead of 6.

"stages" that are nothing but bare platforms extending from one wall of the auditorium. A real stage, with a proscenium wall and opening, serves every possible purpose of the platform stage, and simplifies beyond measure the problems of school dramatics.

The minimum practical size of a proscenium opening is 8 feet in height and 15 feet in width. In an opening smaller than this, the actors look huge and fantastical. The height is determined by the normal "reach" of an adult, which is nearly 8 feet. If the proscenium arch is lower than this dimension, the gestures of the actors go up out of sight! Three or four persons look cramped and crowded in a space narrower than 15 feet. Hence, it is unwise to plan an arch smaller than 8 by 15.

The maximum limit is probably 15 feet in height, and 40 in width. In a bigger opening actors look dwarfed. Professional stages rarely have bigger proscenium openings than this. Probably the most useful medium size is about 12 by 24 or 25. In some new buildings, huge proscenium openings have been built, sometimes 60 or 70 feet in width. These make a great and unnecessary problem for the play producers, especially when stages so built are 10 or 12 feet deep, as is usually the case. If such large stages are needed for any purpose, for example, to hold a large graduating class at commencement exercises, it is possible to secure the same amount of floor space by making the stage narrower and deeper.

In any case, whatever the size of the proscenium opening, but especially when it is very large, it should be possible to cut down its size with a "teaser" and "tormentors." A teaser is a curtain hanging over the opening; and tormentors are two upright pieces, usually frames covered with canvas or some other material, one of which stands at each side of the opening (Fig. 2). Both teaser and tormentors should be movable. The teaser should never be fastened in a permanent way to the top of the arch so that it cannot be raised or lowered. This is the first and most important of all principles in regard to stage equipment. Everything should be movable and flexible. The teaser should be hung on a pipe or wooden batten, suspended from pulleys by two or three ropes, which are in stage parlance "a set of lines."

The Back-Stage Space

The size of the proscenium opening having been determined, the next problem is the size and lay-out of the back-stage space. There can hardly be too much room back-stage, so here the problem is largely one of determining the minimum limits. The depth of the stage depends on the width of of the opening. The stage should have the proportions of a generously large room, and 18 or 20 feet is a normal depth for a 25- to 30-foot opening. A good rule is that the depth should be about two-thirds of the width of the arch.

On each side of the proscenium arch there should be space for actors and for the storage of properties and scenery. It is to be hoped that in all schools the tremendous educational and artistic possibilities that lie in the designing and constructing of costumes and scenery will be recognized. A play is much more than mere acting. It is a great problem in design. Correctly constructed scenery, and modern lighting equipment and appliances, are absolutely fireproof, so that there can be no objections on this score.[2] It is to make possible the use of scenery and lighting that a certain amount of back-stage space is necessary. The rule is that there should be as much room back-stage as may be conveniently allowed. To this end, no useless walls should be put in. It used to be the custom of school architects, even when they built a real proscenium wall and arch, to make a "stage" that was a mere box, usually elaborately paneled, with a small dressing-room reached by a door on each side of the stage. Such construction makes the use of scenery almost impossible. A real stage should be left bare and open. If the bare stage is unsuitable for assemblies or chapel exercises, an attractive room can be created easily by a set of scenery or by a cyclorama of curtains.

This back-stage space need not necessarily be symmetrical. If it is more convenient, the greater part of it may be at one side. However, the wall on the short side should, if possible, be at least 5 or 6 feet from the edge of the proscenium arch, as otherwise it is impossible to have doors on that side of stage sets. A large space at one side of the stage is often very useful for the storage of material, or it may aid in making the stage a more suitable place for the conduct of classes in stagecraft and other theater arts.

The Overhead Space

The one dimension that remains to be considered is the height of the stage from floor to ceiling. The problem of handling scenery is simplified in a theater which has sufficient overhead space and proper equipment so that much of the scenery can be "flied." "To fly" a piece of scenery is to drag it up out of sight. For this reason, a theater should have at least as much room above the top of the proscenium arch as below it. Some recent theaters have twice as much. At the top of this space, about 6 feet from the roof of the stage, is the "gridiron," which in the modern theater is an elaborate grating or rack of steel. Men who are working on scenery may walk around on top of the grid, and blocks and pulleys may be fastened to any part of it. Three (or more) pulleys fastened to the grid at equal distances from each other, and in a line parallel to the proscenium wall, make it possible to support a drop of any length. The ropes that go from the top of the drop to the pulleys should all be turned in the same direction, run through

[2] The organization of dramatics, the designing and constructing of scenery and costumes, stage lighting, etc., as educational projects, are all discussed and described in full in the author's "Book of Play Production" (D. Appleton and Co., New York. 1926).

a multiple pulley, and down toward the floor to some place where they can be tied. Once every theater had a stout railing containing a set of pins around which the ropes could be tied (Fig. 3). Sometimes this pin rail was on the floor, and sometimes it was on a raised gallery. A set of pulleys and ropes so arranged that they hold a drop is called a set of lines. The more sets a theater has, the easier it is to handle scenery.

In planning school theaters, it is usually impossible to have as much space over the proscenium arch as professional theaters have. And the building of a real gridiron is very expensive. Neither large space nor a true grid is necessary. But as much of this arrangement as is possible should be planned for. Even the smallest theater may have something that serves for a grid, though it be only a heavy beam or two solidly fastened to the ceiling. If necessary, a framework of wood or piping can be supported from the floor. If there is not sufficient overhead room so that drops may be hauled up out of sight, it is necessary to lower the drop, and unfasten the lines. The drop can be rolled up, and thus disposed of, while the lines may be pulled up until they are to be used again. An absolute minimum of space over the proscenium arch is probably about 6 feet. The distance from the floor of the stage to its ceiling, then, must be about 6 feet more than the height of the proscenium opening. But the ceiling should be something more than a mere plastered plane; it should have some devices for the holding of pulleys and sets of lines (Fig. 4).

Such an arrangement is not only invaluable in the handling of scenery, but it works beautifully in solving the lighting problem. Theater lights should never be permanently fastened in any part of the theater—unless it be as footlights. The great secret of good lighting is flexibility. A few spot lights, and one or two strip lights,[3] will be entirely adequate if they may be moved easily from one part of the stage to the other, and raised or lowered at will, as they may be if the theater is equipped with the rudimentary grid that has been suggested.

Other Important Details

A final point to be considered is the finishing of this back-stage space. It may be said that the less it is finished, the better. It needs no elaborate paneling or painting, no wainscoting or ornamenting. It is often highly desirable to leave construction beams exposed, as they are exceedingly useful in placing pulleys, lights, and other equipment. In steel construction, it is possible to leave the I-beams of the ceiling exposed so that they themselves act as a grid. Nothing can be better, or more economical. The back wall itself may be made a most useful object. It should be left plain, and unbroken by doors or windows. Then,

[3] For a discussion of this subject, see "The Book of Play Production," Chapter XIII.

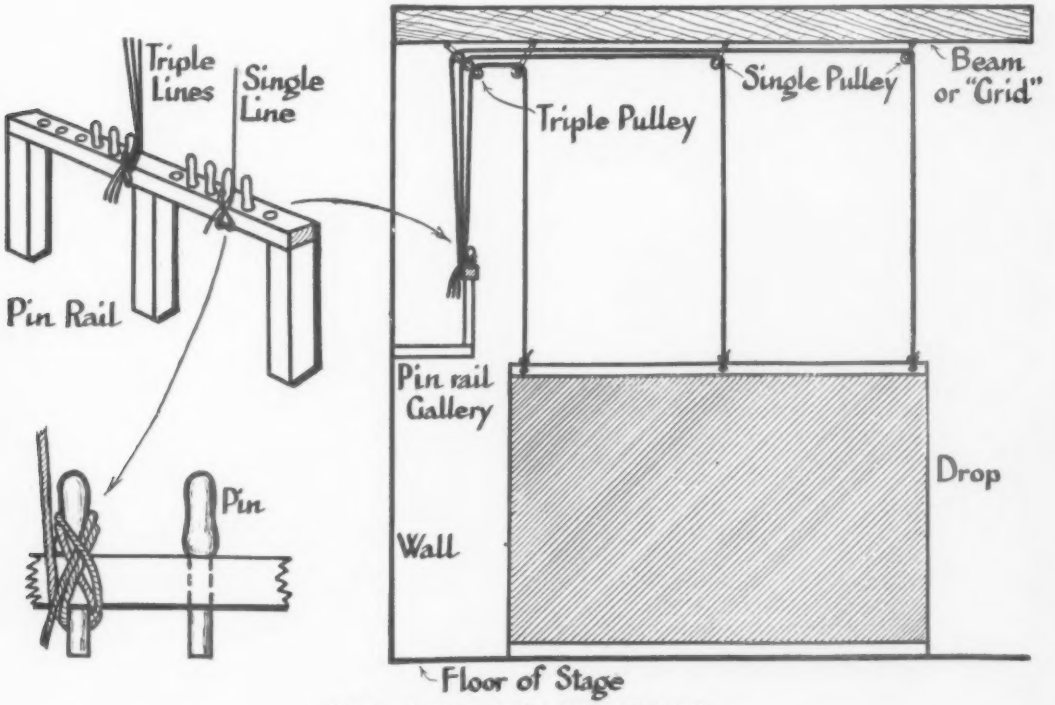


FIG. 3. A STAGE WITH DROP ON LINES

There is sufficient height over the drop so that it can be "flied" out of sight. The pin rail is shown on a gallery, but it may often be placed on the floor (see Fig. 4).

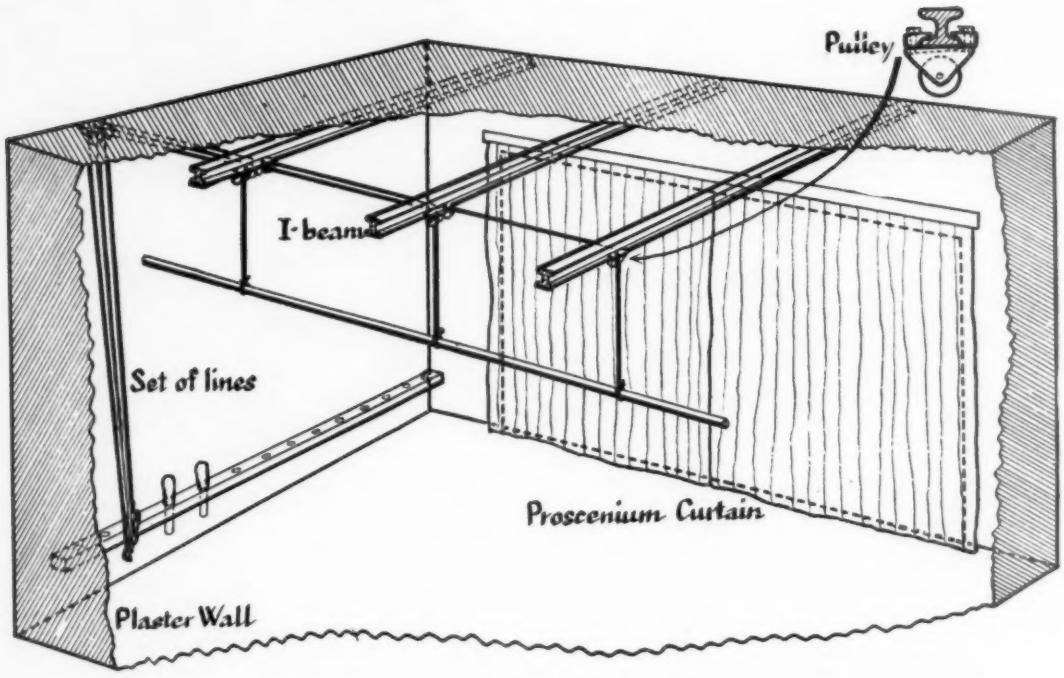


FIG. 4. I-BEAMS CORRECTLY SET IN THE STAGE CEILING

The pipe suspended from the lines may be used for drops and other scenery, or for lighting units. The pulleys are merely clamped to the beams, and may be moved forward or back to any part of the beams. There should be several sets of pulleys. The back wall, roughly plastered, makes an excellent "sky."

if it is plastered roughly, and painted a broken-color blue,[4] it makes a beautiful sky when properly lighted. A plaster sky-wall is highly desirable for all exterior scenes. As has been previously suggested, this rough plaster back wall, and the more or less unfinished stage walls, may be covered by a set of scenery or by curtains, when the auditorium is used for concerts or assemblies. The floor of a stage should always be of soft wood, except possible the "apron," which is the part that extends in front of the curtain. A hardwood floor is a tremendous nuisance, as stage "pegs" cannot be driven into it without great difficulty.

Nothing has been said about entrances and exits, or workshops and storerooms. Of course, these matters must be remembered. There should, if possible, be one large door leading off the stage, so that scenery and heavy objects can easily be carried off and on. It is desirable to have stairs or entrances on both sides of the stage, so that actors can get from one side to the other without crossing over the stage. A "scene-dock," or small room for storing scenery, is exceedingly useful. Of course, dressing-rooms are desirable, but if the stage is properly arranged as to exits, classrooms or any other rooms not being used at the time of performance serve just as well, and save that much space. A workshop for the construction of scenery is sometimes planned, but if the stage is correctly built, and if it is what it should be, it makes the best of all possible workshops for stagecrafts.

Trained teachers, working in simple but properly constructed stages in our schools and colleges, can make play production a vital and valuable factor in American education.

[4] See "The Book of Play Production," pages 142 and 111.

Uniform Cost Accounting for Schools

BY HERBERT N. MORSE

ASSISTANT COMMISSIONER OF EDUCATION

and

CHARLES D. ANDERSON

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THE need for uniformity in school cost accounting became urgent when school costs began to mount rapidly with the increased offerings in the educational programs and the change of policies. It became necessary for many school systems to justify their expenditures. Such justification was usually through comparison with other school systems. Comparisons could be made only with those school systems having uniform financial, pupil and teacher accounting systems.

Uniform Classification of Accounts on a Contractual Basis Essential

In uniform cost accounting the first prerequisite is a uniform system of school financial accounting. A comparison of the financial reports of the states in 1910 and 1927 showed that the tendency is towards uniformity, which may be chiefly attributed to the activities of the United States Bureau of Education. The most significant progress has been in only a few states, notably in Idaho, Indiana, New Jersey, New York, Pennsylvania and Wisconsin.

However, in many of the states it is almost impossible to compute from the financial record books the exact expense of any given year's schooling, because of at least two facts: (1) there is no clear-cut distinction between the various functions or activities; (2) transactions are usually reported on a disbursement basis, that is, when a bill is paid. If the same standard of classification of accounts were used by all states in their entirety, there would be no question of uniformity in regard to functions or activities. True financial accounting takes into consideration all obligations made. In order to carry out this principle, any charge against an appropriation should be made when the obligation is incurred and not when the bill is presented for payment, which may be weeks or months afterwards. Such an accounting will at any stated time give the true financial standing of any school district. Keeping the financial accounts on a contractual basis serves as a check on the expenditures for any budget item.

Uniformity demands that the small districts as well as the large districts should keep their financial accounts sufficiently comprehensive to cover all aspects of financial management. It has been stated time and time again that the smaller districts cannot keep these records, because of lack of clerical help. Complete directions and supervision readily overcome this objection.

Basis of the New Jersey Financial Record Forms for Schools

Every school district in New Jersey uses the same financial record forms, which far surpasses the recommendations of the United States Bureau of Education. The present uniform bookkeeping system was put into effect in the larger districts on July 1, 1924, and the remaining districts on July 1, 1925. In designing this system it was necessary to meet the requirements of the larger school districts and at the same time make it applicable to the smaller school districts. It was necessary to consider:

(1) That the intent of the law be carried out in each district;

(2) That the board of education be held strictly responsible for keeping within the appropriations granted them by the people for the maintenance and support of the schools;

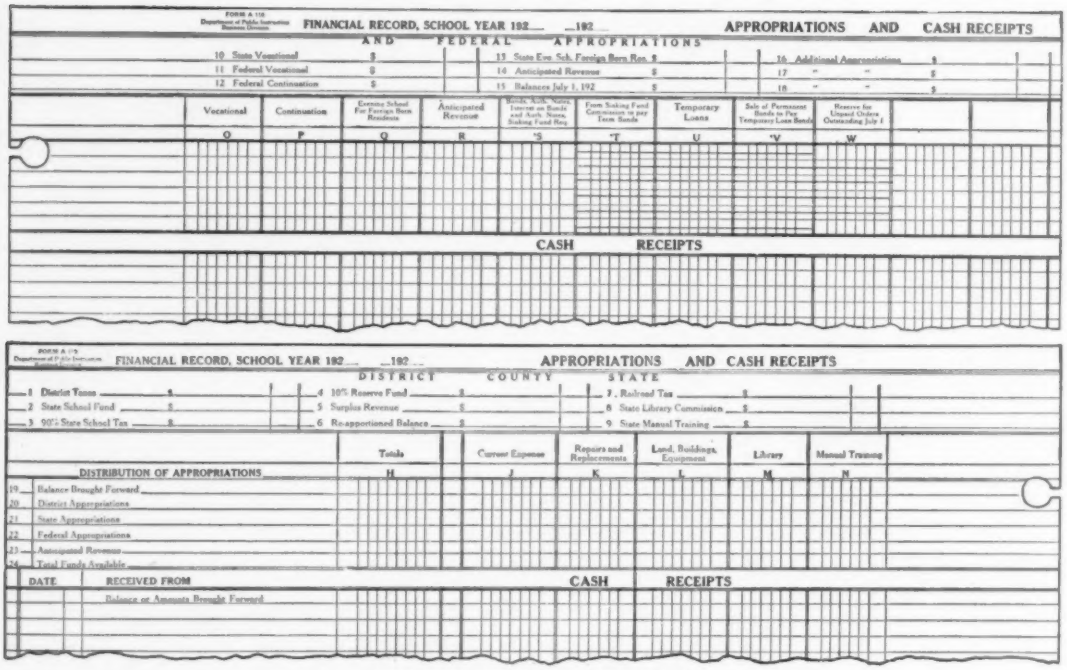
(3) That all orders carrying money obligations against the several accounts under the charge of the board of education, go to the secretary or district clerk for signature before being placed with the vendors;

(4) That adequate directions for carrying out this system in detail be provided to each secretary or district clerk of a school district, so that uniformity may be secured in the operation of the system.

In 1921 a survey of accounting and business systems of all school districts in New Jersey under a Distribution of Bills Paid accounting system was made. A similar survey under the Distribution from Contractual Order system is now being conducted. Comparing the results of these two surveys, the small as well as the large school districts showed better and more accurate records and reports under the contractual system.

The Forms and Their Use

Some states claim that their laws prohibit the use of a United States Standard System of classification, but the state laws do not prohibit this classification but stipulate that certain accounts shall be kept. This classification of accounts can be added to those accounts already required by law. In New Jersey the laws require that separate


FORM A 110
Department of Public Instruction
Business Division

FINANCIAL RECORD, SCHOOL YEAR 192__ __192__ APPROPRIATIONS AND CASH RECEIPTS

STATE AND FEDERAL APPROPRIATIONS

10 State Vocational $ | 13 State Eve. Sch. Foreign Born Res. $ | 16 Additional Appropriations $
11 Federal Vocational $ | 14 Anticipated Revenue $ | 17 " " $
12 Federal Continuation $ | 15 Balances July 1, 192 $ | 18 " " $

	Vocational	Continuation	Evening School For Foreign Born Residents	Anticipated Revenue	Bonds, Sch. Notes, Interest on Bonds and Sch. Notes, Sinking Fund Req.	From Sinking Fund Commission to pay Term Bonds	Temporary Loans	Sale of Permanent Bonds to Pay Temporary Loan Bonds	Reserve for Unpaid Orders Outstanding July 1		
	O	P	Q	R	*S	*T	U	*V	W		

CASH RECEIPTS

FORM A 111
Department of Public Instruction
Business Division

FINANCIAL RECORD, SCHOOL YEAR 192__ __192__ APPROPRIATIONS AND CASH RECEIPTS

DISTRICT COUNTY STATE

1 District Taxes $ | 4 10% Reserve Fund $ | 7. Railroad Tax $
2 State School Fund $ | 5 Surplus Revenue $ | 8 State Library Commission $
3 90% State School Tax $ | 6 Re-apportioned Balance $ | 9 State Manual Training $

DISTRIBUTION OF APPROPRIATIONS	Totals H	Current Expense J	Repairs and Replacements K	Land, Buildings, Equipment L	Library M	Manual Training N
19 Balance Brought Forward						
20 District Appropriations						
21 State Appropriations						
22 Federal Appropriations						
23 Anticipated Revenue						
24 Total Funds Available						

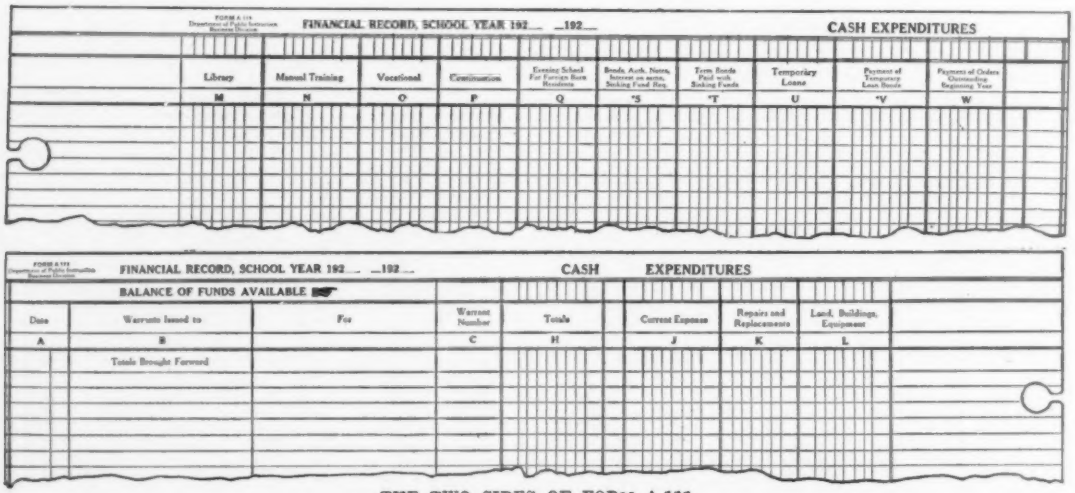
DATE	RECEIVED FROM	CASH RECEIPTS				
	Balance or Amounts Brought Forward					

THE TWO SIDES OF FORM A-110

accounts shall be kept for current expense, repairs and replacement, manual training, vocational, continuation classes, evening schools for foreign-born residents, library, debt service, and capital outlay. The three forms used for this accounting are A-110, A-111 and A-112. Each account has a code letter; for example, current expense has the code letter "J." Form A-110 is used for cash receipts, A-111 for cash expenditures, and A-112 for contractual orders and used as a general control sheet. These various accounts do not prohibit the addition of forms for the distribution of expenditures according to the uniform classification recommended.

The New Jersey system requires that all expenditures be classified in addition to the accounts mentioned in form A-110, A-111 and A-112 according to the recommendations of the United States Bureau of Education, namely, administration, instruction (supervisory and instruction proper), operation, maintenance, coordinate activities, auxiliary agencies, and fixed charges. Instruction (supervisory and instruction proper), operation, maintenance, coordinate activities, auxiliary agencies, and fixed charges are further classified according to types of schools. The system permits still further extensions.

The most important financial record in New


FORM A 111
Department of Public Instruction
Business Division

FINANCIAL RECORD, SCHOOL YEAR 192__ __192__ CASH EXPENDITURES

	Library	Manual Training	Vocational	Continuation	Evening School For Foreign Born Residents	Bonds, Sch. Notes, Interest on notes, Sinking Fund Req.	Term Bonds Paid with Sinking Funds	Temporary Loans	Payment of Temporary Loan Bonds	Payment of Orders Outstanding Beginning Year	
	M	N	O	P	Q	*S	*T	U	*V	W	

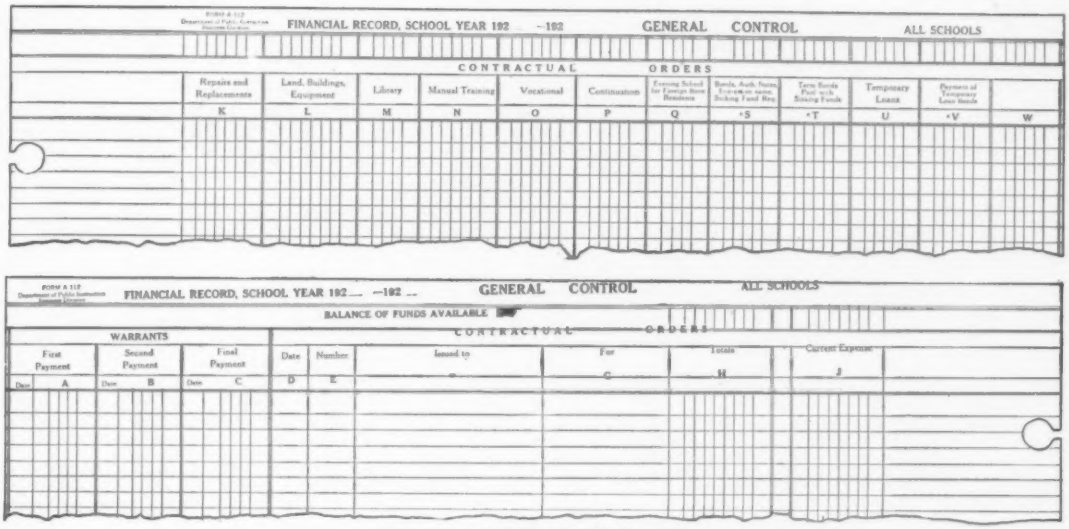
FORM A 111
Department of Public Instruction
Business Division

FINANCIAL RECORD, SCHOOL YEAR 192__ __192__ CASH EXPENDITURES

BALANCE OF FUNDS AVAILABLE ☛

Date	Warrants Issued to	For	Warrant Number	Totals	Current Expense	Repairs and Replacements	Land, Buildings, Equipment
A	B		C	H	J	K	L
	Totals Brought Forward						

THE TWO SIDES OF FORM A-111


FORM A-112
Department of Public Instruction
Business Division

FINANCIAL RECORD, SCHOOL YEAR 192 —192 GENERAL CONTROL ALL SCHOOLS

CONTRACTUAL ORDERS

Repairs and Replacements	Land, Buildings, Equipment	Library	Manual Training	Vocational	Continuation	Evening School for Foreign Born Residents	Bonds, Auth. Issue, Retirement same, Sinking Fund Req.	Term Bonds Paid with Sinking Funds	Temporary Loans	Payment of Temporary Loan Bonds	
K	L	M	N	O	P	Q	*S	*T	U	*V	W

FORM A-112
Department of Public Instruction
Business Division

FINANCIAL RECORD, SCHOOL YEAR 192 —192 GENERAL CONTROL ALL SCHOOLS

BALANCE OF FUNDS AVAILABLE

WARRANTS

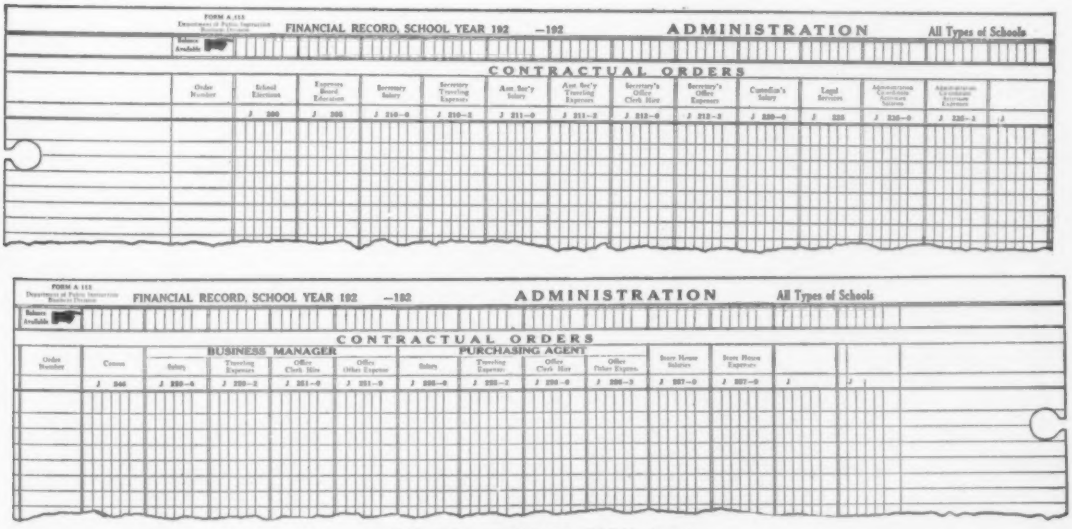
First Payment		Second Payment		Final Payment		Date	Number	CONTRACTUAL ORDERS Issued to	For	Totals	Current Expense
Date	A	Date	B	Date	C	D	E	—	G	H	J

THE TWO SIDES OF FORM A-112

Jersey is the budget, which is shown in forms A-100 to 107. It will be noted that it is a most complete statement of estimated expenditures by functions and activities and serves as a basis for control of all financial transactions. Cubberly states: "Better budget methods invariably demand better accounting methods, and better accounting methods naturally lead to the preparation of better annual budgets." New Jersey requires a complete system of accounts to make such a budget. The more carefully and accurately the system is kept, the better will be the budget. It will also be noticed that each item is coded according to account and purpose, which arrangement ties it up with the rest of the accounting system.

In form A-110 there are three sections. The first section provides space for recording the appropriations, from local, state, federal, other sources and previous year's balances. The second section provides for the distribution of these appropriations to their respective funds. In the third section the actual cash receipts are entered as received.

Form A-111 is the form used for cash expenditures. At the top of this form are headings marked "Balance of Funds Available" for each fund, in which are entered the totals of the several appropriations as determined on line 24, form A-110. All warrants drawn for school expenditures are to be entered in numerical order. The differences between these appropriations and the footings of the expenditures made, show the amount of unexpended appropriations.


FORM A-113
Department of Public Instruction
Business Division

FINANCIAL RECORD, SCHOOL YEAR 192 —192 ADMINISTRATION All Types of Schools

Balance Available

CONTRACTUAL ORDERS

Order Number	School Elections	Expenses Board Education	Secretary Salary	Secretary Traveling Expenses	Asst. Sec'y Salary	Asst. Sec'y Traveling Expenses	Secretary's Office Clerk Hire	Secretary's Office Expenses	Custodian's Salary	Legal Services		
	$ 200	$ 205	$ 210—0	$ 210—2	$ 211—0	$ 211—2	$ 212—0	$ 212—2	$ 220—0	$ 225	$ 230—0	$ 230—2

FORM A-113
Department of Public Instruction
Business Division

FINANCIAL RECORD, SCHOOL YEAR 192 —192 ADMINISTRATION All Types of Schools

Balance Available

CONTRACTUAL ORDERS

Order Number	Census	BUSINESS MANAGER Salary	Traveling Expenses	Office Clerk Hire	Office Other Expense	PURCHASING AGENT Salary	Traveling Expenses	Office Clerk Hire	Office Other Expens.	Store House Salaries	Store House Expenses		
	$ 240	$ 250—0	$ 250—2	$ 251—0	$ 251—2	$ 260—0	$ 260—2	$ 261—0	$ 261—2	$ 267—0	$ 267—0	1	2

THE TWO SIDES OF FORM A-113

FINANCIAL RECORD, SCHOOL YEAR 192 —192 ADMINISTRATION (CITY) All Types of Schools

Balance Available

DISTRIBUTION OF COSTS

Order Number	SUPERVISORS							AUTOMOBILES AND TRUCKS					
	Bldg's & Eqp't Salary	Bldg's & Eqp't Other Expense	Bldg's & Eqp't Clerk Hire	Jan. Service Salary	Jan. Service Other Expense	Architect Engineer Salary—Exp.	Operation Maintenance Admin. Bldg's	Purchase Cost	Drivers' and Helpers' Salary	Supplies	Maintenance	Teacherages	Other Expense
	$ 260—0	$ 260—2	$ 261—0	$ 265—C	$ 265—2	$ 266	$ 267	$ 270	$ 270—0	$ 270—5	$ 270—6	$ 271	$ 274

FINANCIAL RECORD, SCHOOL YEAR 192 —192 ADMINISTRATION (CITY) All Types of Schools

Balance Available

DISTRIBUTION OF COSTS

Order Number	SUPERINTENDENT		ASSISTANT SUPERINTENDENT		SUPT AND ASSISTANTS							Other Expense
	Salary	Traveling Expenses	Salary	Traveling Expenses	Office Clerk Hire	Office Other Expense	Supervision Vocational Relations	Research Activities				
	$ 275—0	$ 275—2	$ 278—0	$ 278—2	$ 279—0	$ 279—5	$ 282	$ 285			$	$ $ 299

THE TWO SIDES OF FORM A-114

FINANCIAL RECORD, SCHOOL YEAR 192 —192 INSTRUCTION

Balance Available

DISTRIBUTION OF COSTS

Order Number	SUPERVISORS AND NON-TEACHING PRINCIPALS				Teachers Salary	TEXT BOOKS			Supplies	Other Expense
	Salary	Clerk Hire	Traveling Expenses	Office Expenses		For Pupils	Pupil's Reference	Teacher's Reference		
	$ 300—0	$ 307—0	$ 308—2	$ 308—3	$ 401—0	$ 401—4	$ 401—4a	$ 401—4b	$ 401—5	$ 401—9

FORM A-115

FINANCIAL RECORD, SCHOOL YEAR 192 —192 INSTRUCTION (SUPERVISORY)

Balance Available

DISTRIBUTION OF COSTS

Order Number	SUPERVISORS				NON-TEACHING PRINCIPALS				MANUAL TRAINING SUPERVISORS	
	Salary	Clerk Hire	Traveling Expenses	Office Expenses	Salary	Clerk Hire	Traveling Expenses	Office Expenses	Salary	Expenses
	$ 300—0	$ 307—0	$ 308—2	$ 308—3	$ 310—0	$ 311—0	$ 310—2	$ 310—3	M 300—0	M 310—3

FORM A-116

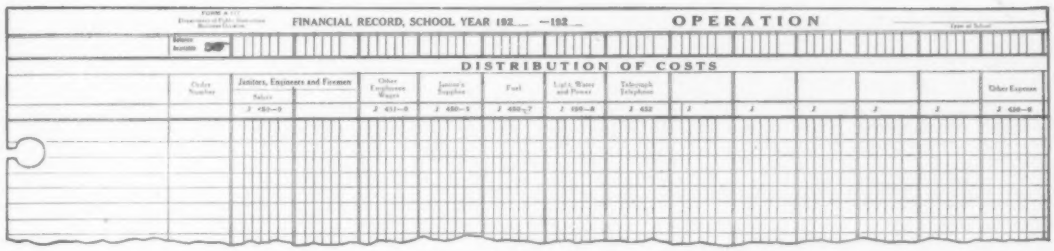
FINANCIAL RECORD, SCHOOL YEAR 192 —192 INSTRUCTION (PROPER)

Balance Available

DISTRIBUTION OF COSTS

Order Number	Teacher's Salary	TEXT BOOKS			Supplies	Other Expense		MANUAL TRAINING			
		For Pupils	Pupil's Reference	Teacher's Reference				Teacher's Salary	Supplies	Other Expense	
	$ 401—0	$ 401—4	$ 401—4a	$ 401—4b	$ 401—5	$ 401—9	$	M 404—0	M 404—5	M 404—9	M

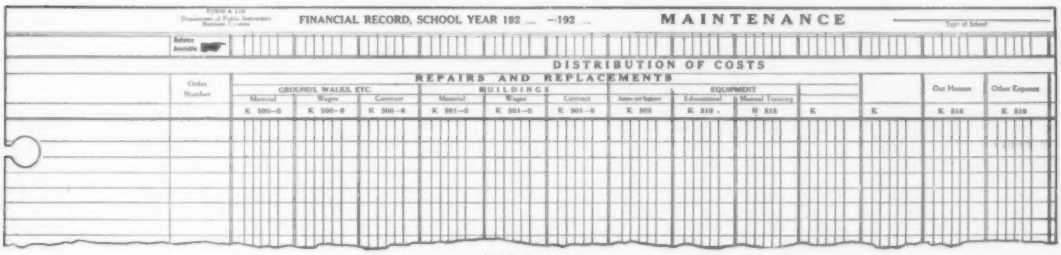
FORM A-116 A


FINANCIAL RECORD, SCHOOL YEAR 192__ —192__ OPERATION

DISTRIBUTION OF COSTS

Order Number | Janitors, Engineers and Firemen: Salary | Other Employees' Wages | Janitor's Supplies | Fuel | Light, Water and Power | Telephone and Telegraph | | | | | | Other Expenses

FORM A-117

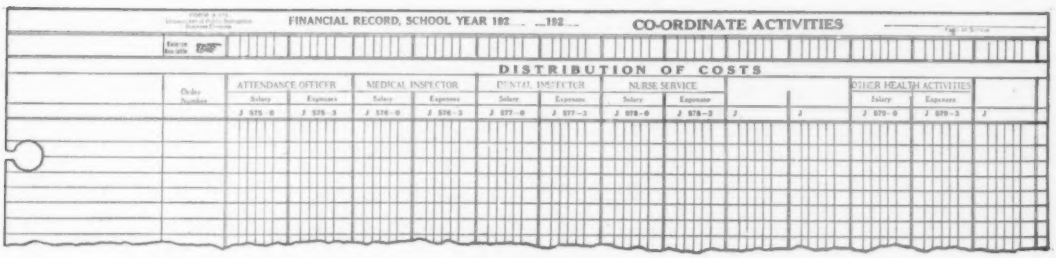

FINANCIAL RECORD, SCHOOL YEAR 192__ —192__ MAINTENANCE

DISTRIBUTION OF COSTS

REPAIRS AND REPLACEMENTS

Order Number | GROUNDS, WALKS, ETC.: Material, Wages, Contract | BUILDINGS: Material, Wages, Contract | EQUIPMENT: Janitors' Supplies, Educational, Manual Training | | | Out Houses | Other Expenses

FORM A-118


FINANCIAL RECORD, SCHOOL YEAR 192__ —192__ CO-ORDINATE ACTIVITIES

DISTRIBUTION OF COSTS

Order Number | ATTENDANCE OFFICER: Salary, Expenses | MEDICAL INSPECTOR: Salary, Expenses | DENTAL INSPECTOR: Salary, Expenses | NURSE SERVICE: Salary, Expenses | | | OTHER HEALTH ACTIVITIES: Salary, Expenses | |

FORM A-119

Form A-112 is used for all contractual orders or obligations made by the board of education. At the top of this form are headings marked "Balance of Funds Available," and the same amounts will be entered as in the cash expenditure form (form A-111). The difference between the footings of the various columns and the balance available as shown at the top of the page will give the unencumbered balance in each fund. Provision is made in columns "A," "B" and "C" to post the warrants given in payment of the orders issued. The distribution of costs is made from form A-112 to forms A-113 to A-127, inclusive.

The contractual system necessitates the use of the Purchase Order which is shown in form A-151. When this order is made, it should be in triplicate or quadruplicate as required by its use. It should be completely made out in all details to be of value. The order must be signed by the district clerk or secretary of the board of education, as he is the official business representative. He must know the obligations the board of education has contracted in order to make the proper entries. Such an order is an obligation incurred and should be entered in form A-112.

The Interpretation of School Accounting

The purpose of school accounting has not been completely fulfilled when each business transaction has been carefully and accurately recorded. This accounting must show more than the fact that expenditures have been honestly made and used for the purposes raised. It must be interpreted in a clear and simple manner to the public in order to show that the schools are more productive and that every dollar spent is returning value received. The educational phases of a school system are closely related to the financial accounting. Every educational activity must be justified in order to obtain adequate support. Many times comparisons with other school systems are made to justify expenditures for certain activities or to increase such expenditures or to determine policies.

A uniform system of accounting facilitates comparisons between school systems, otherwise such comparison would have no value. Comparisons in regard to expenditures for such activities can only be made on the basis of unit costs, and not on the basis of total cost. Again, it may be desirable to make comparisons within a school system

FINANCIAL RECORD, SCHOOL YEAR 192 —192 AUXILIARY AGENCIES

DISTRIBUTION OF COSTS

Order Number	LIBRARY: Salary	Books	Apparatus	Educational Works of Art	Magazines and Periodicals	Public Lectures	Lunch Room	Community Center	Operation of Playgrounds	Athletics	School Gardens	School Savings Banks	
	M 600	M 601	M 602	M 603	J 604	J 605	J 606	J 607	J 608	J 611	J 612	J 615	J

FINANCIAL RECORD, SCHOOL YEAR 192 —192 AUXILIARY AGENCIES

DISTRIBUTION OF COSTS

Order Number	TRANSPORTATION: To Other Districts	Within the District	Order Number	TRANSPORTATION: To Other Districts	Within the District	Order Number	TRANSPORTATION: To Other Districts	Within the District	Order Number	TRANSPORTATION: To Other Districts	Within the District	Order Number	Other Expenses
	J 617	J 618		J 617	J 618		J 617	J 618		J 617	J 618		J 619
			Amounts Forwarded			Amounts Forwarded			Amounts Forwarded				

THE TWO SIDES OF FORM A-120

FINANCIAL RECORD, SCHOOL YEAR 192 —192 FIXED CHARGES

DISTRIBUTION OF COSTS

Order Number	Tuition	Pensions	Rent	Insurance Premiums	Compensation Insurance	Interest on Temporary Loans / Other Expense	Order Number	Tuition	Pensions	Rent	Insurance Premiums	Compensation Insurance	Interest on Temporary Loans / Other Expense
	J 670	J 671	J 672	J 673	J 674	J 679		J 670	J 671	J 672	J 673	J 674	J 679

FORM A-121

FINANCIAL RECORD, SCHOOL YEAR 192 —192 CAPITAL OUTLAY

DISTRIBUTION OF COSTS

Order Number	LAND: New Sites	Improvement to Old Sites	Fences Walks Drives	NEW BUILDINGS: Construction	Heating and Lighting Plant and Other Permanent Fixtures	Landscaping and Playgrounds	Furniture and Equipment			
	L 700	L 701	L 702	L 703	L 713	L 715	L 717	L	L	L

FINANCIAL RECORD, SCHOOL YEAR 192 —192 CAPITAL OUTLAY

DISTRIBUTION OF COSTS

Order Number	OLD BUILDINGS: Alterations	Architect's and Engineer's Fees	Landscaping and Playgrounds	Furniture and Equipment	Administration Offices New Equipment	Manual Training New Equipment	Vocational New Equipment			Out Houses
	L 723	L 723	L 725	L 727	L 733	H 740	O 740	L	L	L 740

THE TWO SIDES OF FORM A-122

(FORMS A-123 TO A-127 ARE SHOWN ON THE OPPOSITE PAGE)

FORM A 122 — FINANCIAL RECORD, SCHOOL YEAR 192__ —192__ — MANUAL TRAINING EVENING SCHOOL

Balance Available

DISTRIBUTION OF COSTS

Order Number	SUPERVISORS AND NON-TEACHING PRINCIPALS: Salary	Clerk Hire	Traveling Expenses	Office Expenses	Teachers Salary	Text Books	Supplies	Other Expense	Repairs and Replacements				
	M 800–0	M 801–0	M 800–2	M 800–3	M 802–0	M 802–4	M 802–5	M 802–9	M 805				M

FORM A 123 — FINANCIAL RECORD, SCHOOL YEAR 192 —192__ — VOCATIONAL — Type of School

Balance Available

DISTRIBUTION OF COSTS

Order Number	COUNTY ADMINISTRATION: Salary Director and Asst.	Traveling Expenses	Salary Secretary Business Mgr.	Office Expenses	Salary Clerks	SUPERVISORS AND NON-TEACHING PRINCIPALS: Salary	Traveling Expenses	Office Expenses	Salary Clerks	INSTRUCTION PROPER: Salary Teachers	Text Books	Supplies	Other Expenses
	O 807–0	O 807–2	O 808–0	O 808–3	O 809–0	O 810–0	O 810–2	O 810–3	O 811–0	O 812–0	O 812–4	O 812–5	O 812–9

FORM A 124 — FINANCIAL RECORD, SCHOOL YEAR 192__ —192__ — VOCATIONAL — Type of School

Balance Available

DISTRIBUTION OF COSTS

Order Number	OPERATION: Janitors Salary	Janitors Supplies	Fuel	Light, Water and Power	Other Expense	Other Employees Wages	MAINTENANCE: Repairs Bldgs. & Grounds	Renewals Fur. & Equip.	AUXILIARY AGENCIES: Aux. Officers Salary & Exp.	Med. Inspection and Nurses	Library and Reference Bks.		
	O 813–0	O 813–5	O 813–7	O 813–8	O 813–9	O 814–0	O 815	O 816	O 817	O 818	O 819	O	O

FORM A 125 — FINANCIAL RECORD, SCHOOL YEAR 192__ —192__ — CONTINUATION — Full Time or Part Time — Type

Balance Available

DISTRIBUTION OF COSTS

Order Number	SUPERVISORS AND NON-TEACHING PRINCIPALS: Salary	Clerk Hire	Traveling Expenses	Office Expenses	Teachers Salary	Text Books	Supplies	JANITORS: Salary	Supplies	Other Expenses			
	P 830–0	P 831–0	P 830–2	P 830–3	P 832–0	P 832–4	P 832–5	P 833–0	P 833–5	P 835–9			

FORM A 126 — FINANCIAL RECORD, SCHOOL YEAR 192__ —192__ — EVENING SCHOOL FOR FOREIGN BORN RESIDENTS

Balance Available

DISTRIBUTION OF COSTS

Order Number	Principal's Salary	Principal's Clerk Hire	Teacher's Salary	Text Books	Supplies	Janitor's Salary	Heat and Light	Other Expense					
	Q 810–0	Q 811–0	Q 812–0	Q 812–4	Q 812–5	Q 813–0	Q 813–7	Q 813–9	Q	Q	Q	Q	Q

FORM A 127 — FINANCIAL RECORD, SCHOOL YEAR 192__ —192__ — DEBT SERVICE — SCHOOL YEAR 192__ —192__

Balance Available

DISTRIBUTION OF COSTS

Order Number	Redemption of Serial Bonds	Interest on Serial, Term and Temporary Loan Bonds	Redemption of Authorized Notes	Interest on Authorized Notes	Sinking Fund Requirements		Order Number	Redemption of Serial Bonds	Interest on Serial, Term and Temporary Loan Bonds	Redemption of Authorized Notes	Interest on Authorized Notes	Sinking Fund Requirements	
	S 865	S 866	S 870	S 871	S 875			S 865	S 866	S 870	S 871	S 875	

by buildings to determine efficiency. Such a comparison from the standpoint of expenditures can be made only on the basis of unit costs.

The second prerequisite of cost accounting is uniform pupil and teacher accounting. This is necessary in order to obtain uniformity in the computing of unit costs. What unit should be used in determining unit costs? This will depend upon the purpose. The most acceptable unit cost is based on per pupil in average daily attendance. The number of pupils in average daily attendance is obtained by dividing the ag-

Form No. A 151. **PURCHASE ORDER** No.....
BOARD OF EDUCATION

.....N. J.

To ..... Date ..... 192.....

.....

Per your contract, letter or phone quotation F. O. B. .....

Please furnish the materials or services specified below on or before .....
Our order number must appear on all shipments, correspondence and invoices. Invoices must be forwarded to District Clerk. No charges other than those specified below will be allowed.

Our Number	Quantity	Unit	ITEMS	Price	Amount
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16			TOTAL,		

No order valid unless signed by the District Clerk.

Ship to ..... Via .....

.....

P. O. Address ..... *District Clerk* .....

OUR INFORMATION

Requisition No. ..... For School .....

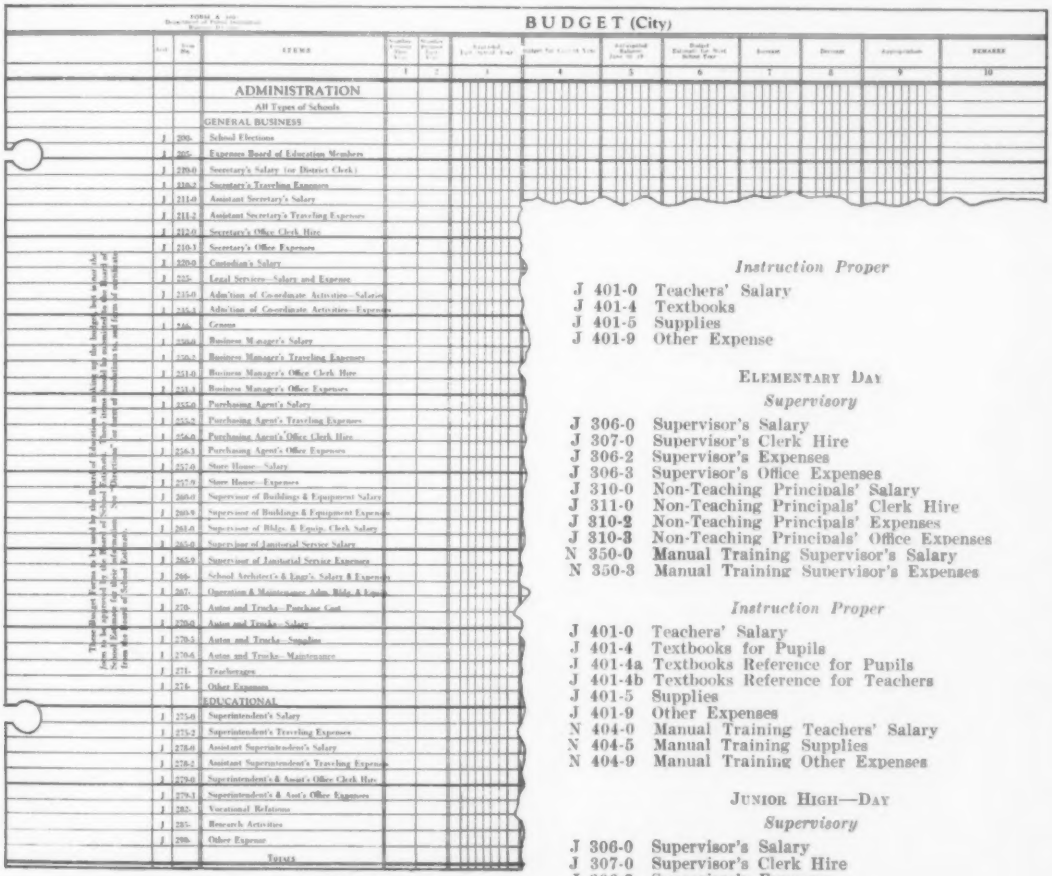
ACCOUNT / SCHOOL	Current Expense		Repairs		Land and Building		Manual Training			
	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount

Extensions ..... Entered .....

FORM A-151

gregate days attendance by the number of days schools were kept open. Unit costs in New Jersey are also based on per pupil in average enrolment. Average enrolment is obtained by dividing the possible number of days attendance by the number of days attendance. The number of pupils in average enrolment shows more clearly the facilities needed than the number of pupils in average daily attendance. The method of computing average daily attendance is practically uniform, but average enrolment at the present time is not, because different methods are used in the various states for computing possible days attendance. In some states a child is dropped from the register after being absent a certain number of days. In New Jersey a child is not dropped from the school register except by moving from the district, by leaving school at the age of sixteen years, or obtaining an "age and schooling certificate" and going to work All districts in New Jersey can be compared with each other because of a common system of financial, pupil and teacher accounting and uniform methods of computing per capita costs.

In conclusion, true cost accounting should be on the contractual basis. Through uniform cost accounting, unit costs are obtained which (1) permit comparisons with other school systems, (2) aid in the making of better budgets, (3) aid in determining policies, (4) determine efficiency. In states where statutory provisions require accounting by certain funds, the United States standard of uniform financial accounting can be interwoven to such accounting, as in the case of New Jersey.



BUDGET (City)

		ITEMS	1	2	4	5	6	7	8	9	10
		ADMINISTRATION									
		All Types of Schools									
		GENERAL BUSINESS									
	J 200-	School Elections									
	J 205-	Expenses Board of Education Members									
	J 210-0	Secretary's Salary (or District Clerk)									
	J 210-2	Secretary's Traveling Expenses									
	J 211-0	Assistant Secretary's Salary									
	J 211-2	Assistant Secretary's Traveling Expenses									
	J 212-0	Secretary's Office Clerk Hire									
	J 210-3	Secretary's Office Expenses									
	J 220-0	Custodian's Salary									
	J 225-	Legal Services—Salary and Expense									
	J 235-0	Admi'tion of Co-ordinate Activities—Salaries									
	J 235-3	Admi'tion of Co-ordinate Activities—Expenses									
	J 240-	Census									
	J 250-0	Business Manager's Salary									
	J 250-2	Business Manager's Traveling Expenses									
	J 251-0	Business Manager's Office Clerk Hire									
	J 251-3	Business Manager's Office Expenses									
	J 255-0	Purchasing Agent's Salary									
	J 255-2	Purchasing Agent's Traveling Expenses									
	J 256-0	Purchasing Agent's Office Clerk Hire									
	J 256-3	Purchasing Agent's Office Expenses									
	J 257-0	Store House—Salary									
	J 257-9	Store House—Expenses									
	J 260-0	Supervisor of Buildings & Equipment Salary									
	J 260-9	Supervisor of Buildings & Equipment Expenses									
	J 261-0	Supervisor of Bldgs. & Equip. Clerk Salary									
	J 265-0	Supervisor of Janitorial Service Salary									
	J 265-9	Supervisor of Janitorial Service Expenses									
	J 266-	School Architect's & Engr's. Salary & Expenses									
	J 267-	Operation & Maintenance Adm. Bldg. & Equip.									
	J 270-	Autos and Trucks—Purchase Cost									
	J 270-0	Autos and Trucks—Salary									
	J 270-5	Autos and Trucks—Supplies									
	J 270-6	Autos and Trucks—Maintenance									
	J 271-	Tracheages									
	J 274-	Other Expenses									
		EDUCATIONAL									
	J 275-0	Superintendent's Salary									
	J 275-2	Superintendent's Traveling Expenses									
	J 278-0	Assistant Superintendent's Salary									
	J 278-2	Assistant Superintendent's Traveling Expenses									
	J 279-0	Superintendent's & Asst's Office Clerk Hire									
	J 279-1	Superintendent's & Asst's Office Expenses									
	J 282-	Vocational Relations									
	J 285-	Research Activities									
	J 290-	Other Expense									
		TOTALS									

ONE SIDE OF BUDGET FORM A-100

The reverse of this form and both sides of forms A-101 to A-105 are ruled in the same way and contain the item numbers and headings and sub-heads shown in the following list.

INSTRUCTION

KINDERGARTEN DAY

Supervisory

J 306-0 Supervisor's Salary
J 307-0 Supervisor's Clerk Hire
J 306-2 Supervisor's Expenses
J 306-3 Supervisor's Office Expenses

Instruction Proper

J 401-0 Teachers' Salary
J 401-4 Textbooks
J 401-5 Supplies
J 401-9 Other Expense

ELEMENTARY DAY

Supervisory

J 306-0 Supervisor's Salary
J 307-0 Supervisor's Clerk Hire
J 306-2 Supervisor's Expenses
J 306-3 Supervisor's Office Expenses
J 310-0 Non-Teaching Principals' Salary
J 311-0 Non-Teaching Principals' Clerk Hire
J 310-2 Non-Teaching Principals' Expenses
J 310-3 Non-Teaching Principals' Office Expenses
N 350-0 Manual Training Supervisor's Salary
N 350-3 Manual Training Supervisor's Expenses

Instruction Proper

J 401-0 Teachers' Salary
J 401-4 Textbooks for Pupils
J 401-4a Textbooks Reference for Pupils
J 401-4b Textbooks Reference for Teachers
J 401-5 Supplies
J 401-9 Other Expenses
N 404-0 Manual Training Teachers' Salary
N 404-5 Manual Training Supplies
N 404-9 Manual Training Other Expenses

JUNIOR HIGH—DAY

Supervisory

J 306-0 Supervisor's Salary
J 307-0 Supervisor's Clerk Hire
J 306-2 Supervisor's Expenses
J 306-3 Supervisor's Office Expense
J 310-0 Non-Teaching Principals' Salary
J 311-0 Non-Teaching Principals' Clerk Hire
J 310-2 Non-Teaching Principals' Expenses
J 310-3 Non-Teaching Principals' Office Expenses
N 350-0 Manual Training Supervisors' Salary
N 350-3 Manual Training Supervisors' Expenses

Instruction Proper

J 401-0 Teachers' Salary
J 401-4 Textbooks for Pupils
J 401-4a Textbooks Reference for Pupils
J 401-4b Textbooks Reference for Teachers
J 401-5 Supplies

J 401-9 Other Expense
N 404-0 Manual Training Teachers' Salary
N 404-5 Manual Training Supplies
N 404-9 Manual Training Other Expense

HIGH SCHOOL—DAY

Supervisory

J 306-0 Supervisor's Salary
J 307-0 Supervisor's Clerk Hire
J 306-0 Supervisor's Expenses
J 306-3 Supervisor's Office Expenses
J 310-0 Non-Teaching Principals' Salary
J 311-0 Non-Teaching Principals' Clerk Hire
J 310-2 Non-Teaching Principals' Expenses
J 310-3 Non-Teaching Principals' Office Expenses
N 350-0 Manual Training Supervisor's Salary
N 350-3 Manual Training Supervisor's Expenses

Instruction Proper

J 401-0 Teachers' Salaries
J 401-4 Textbooks for Pupils
J 401-4a Textbooks Reference for Pupils
J 401-4b Textbooks Reference for Teachers
J 401-5 Supplies
J 401-9 Other Expenses
N 404-0 Manual Training Teachers' Salary
N 404-5 Manual Training Supplies
N 404-9 Manual Training Other Expenses

ELEMENTARY—SUMMER

Supervisory

J 306-0 Supervisor's Salary
J 307-0 Supervisor's Clerk Hire
J 306-2 Supervisor's Expenses
J 306-3 Supervisor's Office Expenses

Instruction Proper

J 401-0 Teachers' Salaries
J 401-4 Textbooks
J 401-5 Supplies
J 401-9 Other Expense

HIGH SCHOOL—SUMMER

Supervisory

J 306-0 Supervisor's Salary
J 307-0 Supervisor's Clerk Hire
J 306-2 Supervisor's Expenses
J 306-3 Supervisor's Office Expenses

Instruction Proper

J 401-0 Teachers' Salaries
J 401-4 Textbooks
J 401-5 Supplies
J 401-9 Other Expense

ELEMENTARY—EVENING

Supervisory

J 306-0 Supervisors' Salary
J 307-0 Supervisors' Clerk Hire
J 306-2 Supervisors' Expenses
J 306-3 Supervisors' Office Expenses

Instruction Proper

J 401-0 Teachers' Salaries
J 401-4 Textbooks
J 401-5 Supplies
J 401-9 Other Expenses

HIGH SCHOOL—EVENING

Supervisory

J 306-0 Supervisors' Salaries
J 307-0 Supervisors' Clerk Hire
J 306-2 Supervisors' Expenses
J 306-3 Supervisors' Office Expenses

Instruction Proper

J 401-0 Teachers' Salaries
J 401-4 Textbooks
J 401-5 Supplies
J 401-9 Other Expenses

SPECIAL INSTRUCTION—(Anaemic, Blind, Cardiacs, Crippled, Deaf, etc.)

Supervisory

J 306-0 Supervisors' Salary
J 307-0 Supervisors' Clerk Hire
J 306-2 Supervisors' Expenses
J 306-3 Supervisors' Office Expenses

Instruction Proper

J 401-0 Teachers' Salaries
J 401-4 Textbooks
J 401-5 Supplies
J 401-9 Other Expense

OPERATION

KINDERGARTEN AND ELEMENTARY—DAY

J 450-0 Janitor's, Engineer's, Firemen's Salaries
J 451-0 Other Employees' Wages
J 450-5 Janitors' Supplies
J 450-7 Fuel
J 450-8 Light, Water & Power
J 452- Telegraph—Telephone
J 450-9 Other Expense

JUNIOR HIGH—DAY

J 450-0 Janitor's, Engineer's, Firemen's Salaries
J 451-0 Other Employees' Wages
J 450-5 Janitors' Supplies
J 450-7 Fuel
J 450-8 Light, Water & Power
J 452- Telegraph—Telephone
J 450-9 Other Expense

HIGH SCHOOL—DAY

J 450-0 Janitor's, Engineer's, Firemen's Salaries
J 451-0 Other Employees' Wages
J 450-5 Janitors' Supplies
J 450-7 Fuel
J 450-8 Light, Water & Power
J 452- Telegraph—Telephone
J 450 9 Other Expense

ELEMENTARY—SUMMER

J 450-0 Janitor's, Engineer's, Firemen's Salaries
J 451-0 Other Employees' Wages
J 450-5 Janitors' Supplies
J 450-7 Fuel
J 450-8 Light, Water & Power
J 452- Telephone—Telegraph
J 450-9 Other Expense

HIGH SCHOOL—SUMMER

J 450-0 Janitor's, Engineer's, Firemen's Salaries
J 451-0 Other Employees' Wages
J 450-5 Janitors' Supplies
J 450-7 Fuel
J 450-8 Light, Water & Power
J 452- Telegraph—Telephone
J 450-9 Other Expense

ELEMENTARY—EVENING

J 450-0 Janitor's, Engineer's, Firemen's Salaries
J 451-0 Other Employees' Wages
J 450-5 Janitors' Supplies
J 450-7 Fuel
J 450-8 Light, Water & Power
J 452- Telegraph—Telephone
J 450-9 Other Expense

HIGH SCHOOL—EVENING

J 450-0 Janitor's, Engineer's, Firemen's Salaries
J 451-0 Other Employees' Wages
J 450-5 Janitors' Supplies
J 450-7 Fuel
J 450-8 Light, Water & Power
J 452- Telegraph—Telephone
J 450-9 Other Expense

MAINTENANCE

KINDERGARTEN AND ELEMENTARY

K 500-5 Material—Rep. & Repl. Grounds, Walks, Fences
K 500-0 Wages—Rep. & Repl. Grounds, Walks, Fences
K 500-6 Repairs made on order or contract
K 501-5 Material—Repairs & Replacements Buildings
K 501-0 Wages—Repairs & Replacements Buildings
K 501-6 Repairs made on order or contract
K 505- Engineers & Janitors Equipment
K 510- Educational Equipment
K 512- Office and Other Equipment
N 515- Manual Training Equipment
K 518- Outhouses
K 519- Other Expense

JUNIOR HIGH SCHOOL

K 500-5 Material—Rep. & Repl. Grounds, Walks, Fences
K 500-0 Wages—Rep. & Repl. Grounds, Walks, Fences
K 500-6 Repairs made on order or contract
K 501-5 Material—Repairs & Replacements Buildings
K 501-0 Wages—Repairs & Replacements Buildings

K 506-6 Repairs made on order or contract
K 505- Engineers & Janitors Equipment
K 510- Educational Equipment
K 512- Office and Other Equipment
N 515- Manual Training Equipment
K 518- Outhouses
K 519- Other Expense

HIGH SCHOOL

K 500-5 Material—Rep. & Repl. Grounds, Walks, Fences
K 500-0 Wages—Rep. & Repl. Grounds, Walks, Fences
K 500-6 Repairs made on order or contract
K 501-5 Material—Repairs & Replacements Buildings
K 501-0 Wages—Repairs & Replacements Buildings
K 501-6 Repairs made on order or contract
K 505- Engineers & Janitors Equipment
K 510- Educational Equipment
N 512- Office and Other Equipment
N 515- Manual Training Equipment
K 518- Outhouses
K 519- Other Expense

COORDINATE ACTIVITIES

ELEMENTARY

J 575-0 Attendance Officer's Salary
J 575-3 Attendance Officer's Expenses
J 576-0 Medical Inspector's Salary
J 576-2 Medical Inspector's Expense
J 577-0 Dental Inspection Salary
J 577-3 Dental Inspection Expense
J 578-0 Nurse Service Salary
J 578-3 Nurse Service Expense
J 579-0 Other Health Activities Salary
J 579-3 Other Health Activities Expense

JUNIOR HIGH SCHOOL

J 575-0 Attendance Officer's Salary
J 575-3 Attendance Officer's Expenses
J 576-0 Medical Inspector's Salary
J 576-3 Medical Inspector's Expense
J 577-0 Dental Inspection Salary
J 577-3 Dental Inspection Expense
J 578-0 Nurse Service Salary
J 578-3 Nurse Service Expense
J 579-0 Other Health Activities Salary
J 579-3 Other Health Activities Expense

HIGH SCHOOL

J 575-0 Attendance Officer's Salary
J 575-3 Attendance Officer's Expenses
J 576-0 Medical Inspector's Salary
J 576-3 Medical Inspector's Expense
J 577-0 Dental Inspection Salary
J 577-3 Dental Inspection Expense
J 578-0 Nurse Service Salary
J 578-3 Nurse Service Expense
J 579-0 Other Health Activities Salary
J 579-3 Other Health Activities Expense

AUXILIARY AGENCIES

ELEMENTARY

M 600- Librarian's Salary
M 601- Library Books
M 602- Apparatus
M 603- Educational Works of Art
J 604- Magazines and Periodicals
J 605- Public Lectures
J 606- Public Lunches & Lunch Room Op. Deficits
J 607- Community Centers
J 609- Operation of Playgrounds
J 611- School Athletics
J 613- School Gardens
J 615- School Savings Banks
J 617- Transportation to Other Districts
J 618- Transportation Within the Districts
J 619- Other Expense

JUNIOR HIGH SCHOOL

M 600- Librarian's Salary
M 601- Library Books
M 602- Apparatus
M 603- Educational Works of Art
J 604- Magazines and Periodicals
J 605- Public Lectures
J 606- Public Lunches & Lunch Room Opn. Deficits
J 607- Community Centers
J 609- Operation of Playgrounds
J 611- School Athletics
J 613- School Gardens
J 615- School Savings Banks
J 617- Transportation to Other Districts
J 618- Transportation Within the Districts
J 619- Other Expense

HIGH SCHOOL

M 600- Librarian's Salary
M 601- Library Books
M 602- Apparatus
M 603- Educational Works of Art
J 604- Magazines and Periodicals
J 605- Public Lectures
J 606- Public Lunches & Lunch Room Opn. Deficits
J 607- Community Centers
J 609- Operation of Playgrounds
J 611- School Athletics
J 613- School Gardens
J 615- School Savings Banks
J 617- Transportation to Other Districts
J 618- Transportation Within the Districts
J 619- Other Expenses

FIXED CHARGES

ELEMENTARY

J 670- Tuition
J 671- Pensions
J 672- Rent
J 673- Insurance Premiums
J 674- Workmen's Compensation Prems. and payments
J 679- Other Expense

JUNIOR HIGH

J 680- Tuition
J 681- Pensions
J 682- Rent
J 683- Fire Insurance Premiums
J 684- Workmen's Compensation Prems. and payments
J 689- Other Expense

HIGH SCHOOL

J 690- Tuition
J 691- Pensions
J 692- Rent
J 693- Fire Insurance Premiums
J 694- Workmen's Compensation Prems. and payments
J 699- Other Expense

CAPITAL OUTLAY

ALL TYPES OF SCHOOLS

L 700- New Sites
L 701- Improvements to Sites
L 702- Walks, Drives, Fences

NEW BUILDINGS

L 703- Construction
L 713- Architects' and Engineers' Fees
L 715- Landscaping and Playgrounds
L 717- Furniture and Equipment

OLD BUILDINGS

L 723- Alterations
L 733- Architects' and Engineers' Fees
L 735- Landscaping and Playgrounds
L 737- Furniture and Equipment
L 738- Administrative Office Equipment

MANUAL TRAINING

N 740- New Equipment

VOCATIONAL

O 745- New Equipment

OTHER ITEMS

L 749- Outhouses

MANUAL TRAINING—EVENING SCHOOL

SUPERVISORY

N 800-0 Supervisor's Salary
N 801-0 Supervisor's Clerk Hire
N 800-3 Supervisor's Expenses

INSTRUCTION PROPER

N 802-0 Teachers' Salaries
N 802-4 Textbooks
N 802-5 Supplies
N 802-9 Other Expense
N 805- Repairs & Replacements

VOCATIONAL

DAY SCHOOL

Supervisory

O 810-0 Supervisor's Salary
O 811-0 Supervisor's Clerk Hire
O 810-3 Supervisor's Expenses

Instruction Proper

O 812-0 Teachers' Salaries
O 812-4 Textbooks
O 812-5 Supplies
O 812-9 Other Expense

Operation

O 813-0 Janitors' Salaries
O 813-5 Janitors' Supplies
O 813-9 Other Expense

Maintenance

O 815- Repairs & Replacements

EVENING SCHOOL

Supervisory

O 820-0 Supervisors' Salaries
O 821-0 Supervisors' Clerk Hire
O 820-3 Supervisors' Expenses

Instruction Proper

O 822-0 Teachers' Salaries
O 822-4 Textbooks
O 822-5 Supplies
O 822-9 Other Expense

Operation

O 823-0 Janitors' Salaries
O 823-5 Janitors' Supplies
O 823-9 Other Expense

Maintenance

O 825- Repairs & Replacements

CONTINUATION

FULL TIME CLASSES

Supervisory

P 830-0 Supervisors' & Non-Teaching Princ. Salary
P 831-0 Supervisors' & Non-Teaching Princ. Clerk Hire
P 830-2 Supervisors' & Non-Teaching Princ. Trav. Exp.
P 830-3 Supervisors' & Non-Teaching Princ. Office Exp.

Instruction Proper

P 832-0 Teachers' Salaries
P 832-4 Textbooks
P 832-5 Supplies

Operation

P 833-0 Janitors' Salaries
P 833-5 Janitors' Supplies
P 833-9 Other Expense

PART TIME CLASSES

Supervisory

P 830-0 Supervisors' & Non-Teaching Princ. Salary
P 831-0 Supervisors' & Non-Teaching Princ. Clerk Hire
P 830-2 Supervisors' & Non-Teaching Princ. Trav. Exp.
P 830-3 Supervisors' & Non-Teaching Princ. Office Exp.

Instruction Proper

P 832-0 Teachers' Salaries
P 832-4 Textbooks
P 832-5 Supplies

Operation

P 833-0 Janitors' Salaries
P 833-5 Janitors' Supplies
P 833-9 Other Expense

EVENING SCHOOLS FOR FOREIGN-BORN RESIDENTS

Supervisory

Q 850-0 Principal's Salary
Q 851-0 Principal's Clerk Salary

Instruction Proper

Q 852-0 Teachers' Salaries
Q 852-4 Textbooks
Q 852-5 Supplies

Operation

O 853-0 Janitor's Salary
Q 853-7 Heat and Light
Q 853-9 Other Expense

DEBT SERVICE

S 865- Redemption of Serial Bonds
S 866- Int. on Serial, Term & Temporary Loan Bonds
S 870- Redemption of Authorized Notes
S 871- Interest on Authorized Notes
S 875- Sinking Fund Requirements

SUMMARY

ADMINISTRATION

INSTRUCTION

Supervisory

Kindergarten
Elementary
Junior High
High Schools
Summer Schools
Evening Schools
Special Instruction

Instruction Proper

Kindergarten
Elementary
Junior High
High Schools
Summer Schools
Evening Schools
Special Instruction

OPERATION

Kindergarten
Elementary
Junior High
Summer Schools
Evening Schools

MAINTENANCE

Kindergarten and Elementary
Junior High
High School

COORDINATE ACTIVITIES

Elementary
Junior High
High School

AUXILIARY AGENCIES

Elementary
Junior High
High School

FIXED CHARGES

Elementary
Junior High
High School

CAPITAL OUTLAY

MANUAL TRAINING EVENING

VOCATIONAL

CONTINUATION

EVE. SCH. FOR FOREIGN-BORN RES.

DEBT SERVICE

Centralized Buying, Storing and Testing of Classroom, Office and Library Supplies for Schools and Colleges

BY THEODORE M. JOHNSON

SUPERVISOR OF PURCHASES, NEW YORK UNIVERSITY

ONE of the functions of school and university management affected by constantly changing conditions is purchasing. The purchasing agent must investigate every new method or article in his field and keep well informed on the fluctuating and highly competitive markets that have developed. Such investigation can be done with a great saving of time in one centralized office, as compared with the duplication of effort involved when the various schools or department heads of an educational organization do their purchasing independently.

An efficient central purchasing office maintains a set of records that give a good history of each product in use or under consideration, as well as information about competing products that will be of great assistance in determining where to purchase the next time. Market conditions are carefully studied, as a result of which the experienced purchasing agent has a much better knowledge of market trends than have the men interested only in obtaining and using the article.

When records are made and kept in one central place, many interesting facts appear. Articles assumed to be in very limited use, for example, may prove from the records to have been purchased frequently and in fairly large quantities, thus justifying greater attention on the part of the purchasing agent.

Purchasing power and the securing of low prices is greatly helped by the combining of operations. The purchaser benefits by contracting in large quantities with deliveries specified at a definite time, and the source of supply is helped as well. Manufacturers like to get large contracts, so that they can work out their production schedules and sales budgets with much greater accuracy.

Getting the Right Goods at the Right Price

It is interesting to study the various sales methods of organizations soliciting business. The pressure used in selling to-day is tremendous. This is especially true in a buyer's market. It is always wise policy to be a good listener and give every one an interview if he is selling a product similar to one that you are constantly purchasing. If a salesman is not treated with courtesy, it is certain that he will circulate his opinions in one way or another. This may not be altogether objectionable, but if you can insure having only good reports circulated, it is to your advantage. This point is brought out because it has always been good business policy to prepare while in a buyer's market for making a good connection when a seller's market exists. There are many purchasing agents who know how difficult it is to make purchases and get prompt deliveries when products are scarce or the demand is great, and the wise ones strive to make contacts with as many dealers as possible within the limits of sound business practice.

Trained personnel is needed in the purchasing department. The centralized records should be kept in such a way that one can obtain information and feel confident that it is correct. But purchasing agents should be discouraged from depending too much on the answer to the question, "What did we pay last time?" Sometimes there is a tendency to place the order at the same price and not bother to consult other agencies to find out whether any change in market conditions has occurred since the last purchase. Or perhaps new improvements have been made during this period. The former price should be used as a gage and not considered, without investigation, the best offer under existing conditions.

Centralized purchasing helps materially in getting invoices paid promptly and in taking advantage of cash discounts at every opportunity. This arrangement of payment of invoices has two very distinct advantages, the first one being that of raising the credit rating of the organization. Few people like to do business with an organization that has a reputation of being slow-paying. It is only fair that the seller should receive its money within the allotted time. Almost every day of the week one can hear among salesmen conversation running something like this: "So-and-so has asked us to quote. Believe me, I will bid high enough with the hope that I shall get the order only at a price at which I could afford to carry this slow-pay account." This kind of statement is detrimental to the buyer. Secondly, there are the direct savings of cash discounts; it is surprising how much money this may amount to in the course of a year. When individual departments make purchases, the invoices usually do not arrive promptly enough in the accounting department to be paid within the customary ten-day period, and there are department heads who still argue that invoices for certain types of equipment should

come to them first and then be forwarded to the accounting office for payment. They are constant objectors to the paying of invoices before they have ascertained that the goods are satisfactory. There are numerous organizations, however, that make a practice of paying certain invoices before the materials have been thoroughly inspected, but this is practiced, of course, only with houses of good reputation.

A university may have branches covering several towns within a state. The purchasing for these branches should receive the same attention as in industrial organizations; both are confronted with this problem of centralization. The fact that within the last ten years a majority of universities have endeavored to educate a much larger student body, has greatly increased the complexity of operating problems. Purchasing was one of the functions that needed immediate attention; therefore, there is to-day a purchasing department in practically every large-sized university.

Before the days of the educational purchasing agent there was more or less hand-to-mouth buying, without preparation for storing some of the material that was in greatest demand. Little thought was given to quantity prices. Material was bought as it was actually needed. There was little uniformity of office and laboratory equipment. It is obvious that when department heads do their own buying it is impossible to have uniformity. In many kinds of equipment and supplies it is only reasonable to assume that one man's careful selection should be satisfactory to the majority; if this fact is accepted by all those in authority, a point is established toward purchasing in quantity, thereby obtaining a much better price arrangement.

Importance of Specifications

Complete specifications should be drawn up before negotiating for a purchase, and a copy should be sent to each of the manufacturers quoting, in order to avoid misunderstanding. Many manufacturers would like to deviate a little, and if their recommendations are allowed, there is bound to be a cheapening of the article in some way not always obvious to the casual observer. There are times, of course, when a recommendation made by a manufacturer may be beneficial to both parties. Careful thought should be given to the matter, however, before changing the specifications.

It should not be the duty of the purchasing agent alone to draw up specifications, for in most organizations there may be men who are more competent to do this than he is; but some one must take the initiative and follow through these activities. A good many organizations solve this problem by forming committees to determine what they think would be the most practical for their particular needs. It is then the purchasing agent's task to make the best possible contact according to the particular specifications outlined.

Salesmen are constantly seeking interviews to tell of their products, and this is a very valuable source of information. The buyer learns of the new developments and can determine whether these can be used to advantage. It is in this way that the purchasing agent is in a position to make recommendations.

Paper and Library Equipment

The purchasing office should be a storehouse of information and should be constantly collecting data. A great proportion of this information is obtainable from trade organizations. Recently a study was made of the types of letterheads used in various universities throughout the country, and the results were amazing. Paper of every description was used and the prices ranged from 57 cents per ream to $2.75 per ream. Various paper tests were made and it developed that some of the medium-priced paper was of very inferior grade.

Library equipment is an entirely different matter from classroom equipment, because it must provide for filing, recording and storing. Great pains must be taken to choose cards that will stand much handling, for library records are referred to repeatedly. The library supply houses carry the best possible grade of cards for this work; almost all are of rag stock. The cabinets used in a library are subject to constant abuse because they are used by so many different persons. This affects the durability of a cabinet, and for this reason great pains should be taken to use proper lumber, proper joint construction and proper finish of woods. It is almost needless to say that a library presents a much neater appearance if a uniform finishing color is used throughout.

Materials Should Be Tested

Educational institutions are fortunate in having various scientific laboratories where tests can be made from time to time. This is convenient and less costly than having tests made in outside laboratories.

The Educational Buyers' Association has contributed much effort in promoting this kind of work. It has had tests made at different universities of the various products that most people are interested in, and this information is compiled and sent to the various members of the Association. An effort is being made to found a fellowship at some institution whereby all the members can feel free to have individual tests made for them.

Such tests are not confined to scientific apparatus or supplies, but include also classroom and library equipment. It is always important to consider the type of chair that is going to be used in a particular place, whether or not the chairs are to be fastened to the floor or are movable,

whether or not it will be necessary to have writing surfaces, whether they should be the widest or the narrowest type. All these conditions depend upon the funds available and also upon the type of student to whom the particular school is catering. Among the things tested are shades of paint, the lighting arrangement, blackboards and their location, erasers and chalk.

Storing of Supplies and Purchasing Procedure

The storing of supplies presents a problem to university organizations. There is the inevitable question of having one central storage room or several storage rooms located at various centers. The writer believes that a centrally located storeroom is usually the most economical. Individual conditions must govern the decision. The perpetual inventory record is really the foundation of a successful storeroom. Most of the important factors such as quantity on hand, quantity to order, amount required over a given period, delivery time necessary, department requisitioning materials, are included on such a record. A signature should always be required when issuing materials from stock, for this protects both the requisitionist and the storekeeper.

When the storekeeper finds by consulting his supply record thot he is running low on certain supplies, he immediately makes out a purchase requisition to the purchasing department. A requisition should be the basis of most of the purchasing agent's activities. Such purchase requisitions come not only from the storekeeper but from all department heads as well.

It is then the purchasing agent's duty to get prices, investigate the quality of the product, make the purchases and follow up the delivery. In accomplishing this many steps are involved. First of all, the purchasing agent should not make a purchase until he is absolutely sure that funds are available for each individual transaction. This is the only thing to do if an organization is to be assured that its purchase budget will be under control at all times.

When a lien has been put against a particular account in the budget, the purchasing agent is safe to make a purchase after carefully investigating market conditions. He will consult his purchase record to learn what was paid for this article in the past. When he is thoroughly convinced that he has received his best offer, he should give instructions to make up the purchase order. These purchase orders should be followed up repeatedly to be doubly sure that material is going to arrive when it is expected.

It should always be remembered that a purchasing department has been organized to function as a service department. Sometimes service departments receive severe criticism if things do not go exactly right. It is always good policy to rectify trouble without antagonizing the critic, because the best kind of coöperation is necessary to make a purchasing department run smoothly. An organization that works in harmony is usually successful.

The Library of the Academy of Richmond County, Augusta, Ga.

BY JUNE RAINSFORD

LIBRARIAN

"PRESENT-DAY teaching methods require the use of many books, and the school library is indispensable as a source of material for the socialized recitation." The foregoing paragraph taken from Martha Wilson's "School Library Management" expresses, in a measure, the purpose of the school library. Students are encouraged to seek many authoritative sources of information, and in order to have them do this intelligently, the modern high school must have as an essential part of its equipment a well-organized library.

To insure the best results from a library, it should be administered by a trained librarian. Young students are bewildered rather than helped when surrounded by a mass of books with no one to introduce them to the material between the covers.

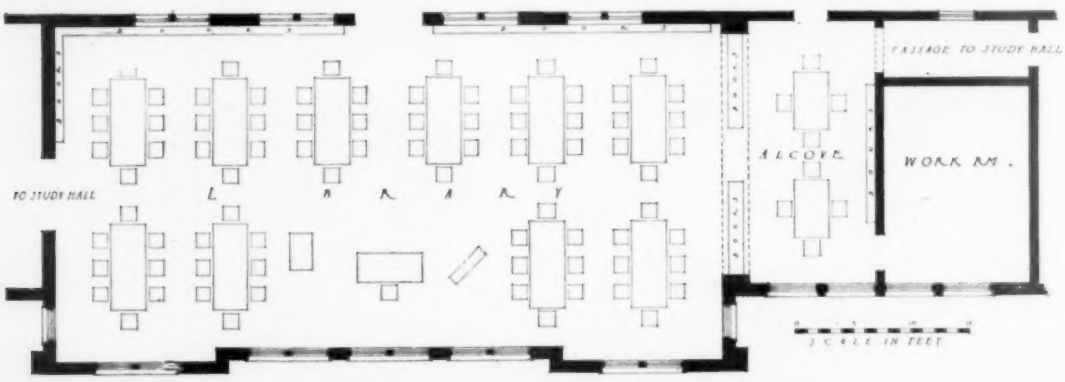
Realizing the importance of the library in modern education, the architects and the school authorities who planned the new building of the Academy of Richmond County of Augusta, Ga., made the location of the library a very desirable one. It is a large room on the third floor of the building in a central position and has an eastern exposure. In planning a library, it is desirable to have the light come from one side, either north or east, thereby insuring bright mornings and shady afternoons.

The main entrance to the library is through double doors from two corridors which intersect at right angles. At the south end of the room double doors open into a large study hall; a very attractive alcove was effected on the north end of the room by a dropped ceiling. At one side of this alcove a door opens into another study hall, and on the other side of the alcove there is an opening into the librarian's work and file room. The plan of having study halls on each side of the library is a very excellent feature in that there is no loss of time by the students in passing from one room to another.

LIBRARY OF THE ACADEMY OF RICHMOND COUNTY, AUGUSTA, GA.—INTERIOR VIEW

The ceiling of the room is white and the walls are a soft buff; the wood work is oak and was planned to harmonize with the dark oak of the furniture. This dark finish stands constant use with much less wear than does the light-finished furniture. The seating capacity of the library takes care of over ten per cent of the student body of the school. At the present time there is shelf space for 5,000 books, and there is room for additional shelves when the necessity arises. Open wall shelves make the books easily accessible to the students. An attractive feature of the shelving is a section of low double shelves across the room, dividing the alcove from the main room. These shelves are used for encyclopedias.

The physical equipment of the new Academy of Richmond County Library is excellent, and it is hoped and believed that it creates for the students an atmosphere in which they can do better school work by having available supplementary material. And not only does the library aim to make actual school work more effective, but it also aims to give the students a permanent interest in and love for the best of all companions—books.



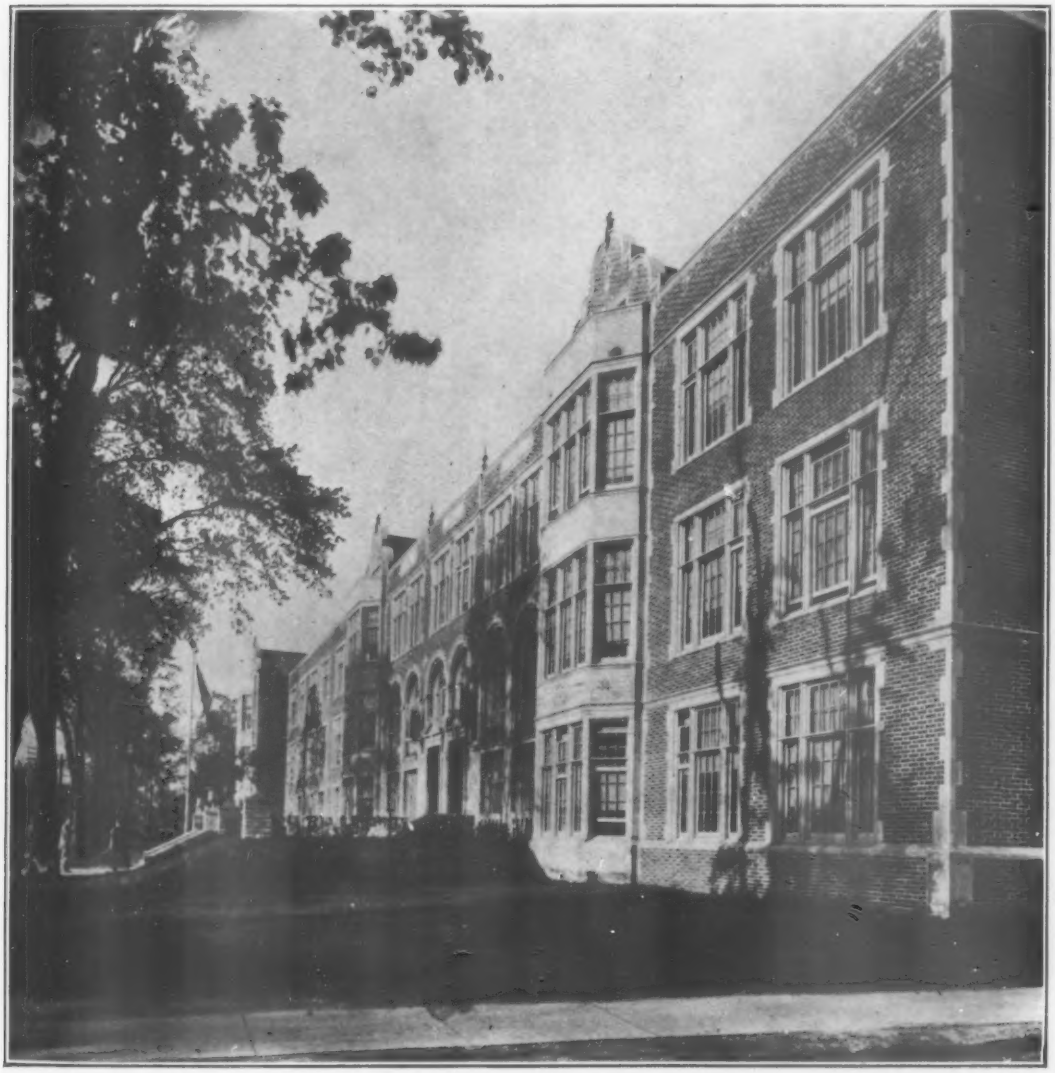
Equipment and Use of the Haven Intermediate School Auditorium, Evanston, Illinois

BY DEAN FARNSWORTH AND WINIFRED WARD

SCHOOL OF SPEECH, NORTHWESTERN UNIVERSITY

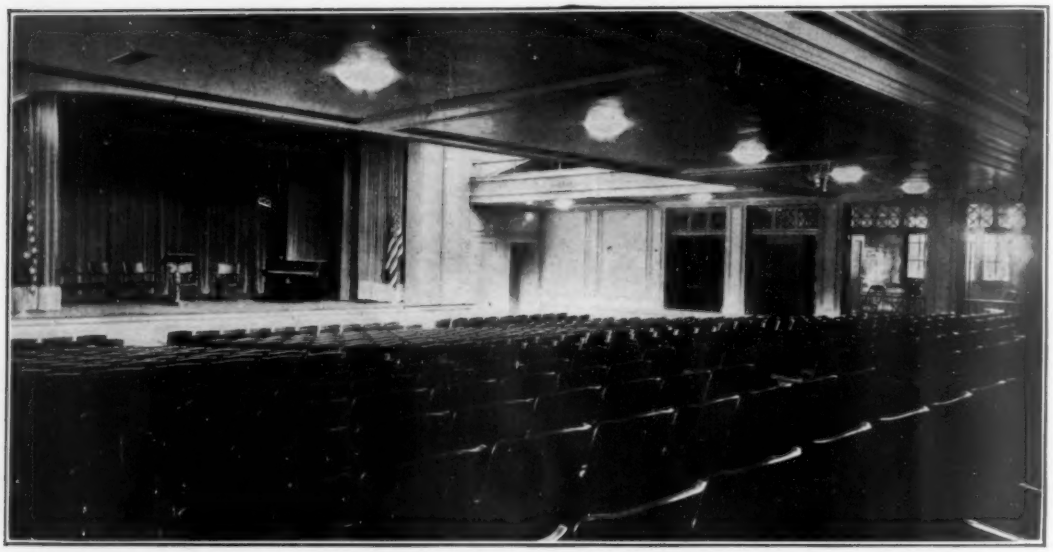
EVERY day of the school year establishes more firmly the worth of a fine auditorium. There are the regular assemblies, when the whole school gathers to hear some fine speaker or singer, a glee club, or a reader, or to see a demonstration from the dramatic classes, or perhaps a finished play. There are the dramatic classes, which meet in the auditorium several periods of every day—classes in creative dramatic work in which the pupils learn a fine type of self-expression and, at the same time, grow in appreciation of the best literature.

A visitor to one of these classes may watch the pupils learning the fundamentals of dramatic work; in pantomime, dramatization, voice and diction. Or he may see them making a dramatic study of a fine old folk-tale. If he visits the next higher class, he will see the pupils building an



Childs & Smith, Chicago, Architects

THE HAVEN INTERMEDIATE SCHOOL, EVANSTON



AUDITORIUM OF THE HAVEN INTERMEDIATE SCHOOL

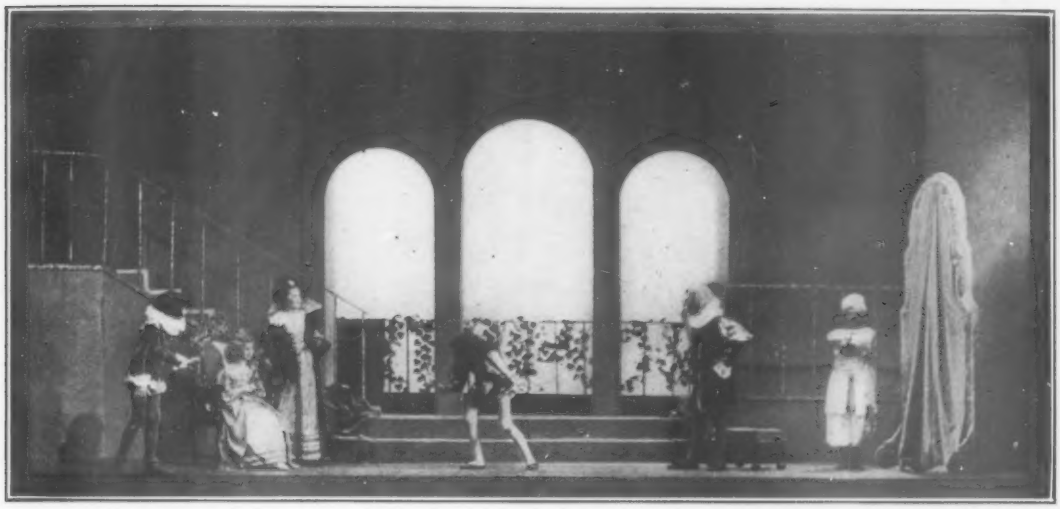
original play from one of the old ballads, or if he visits an advanced class, he will see them working on a scene from "A Midsummer Night's Dream," or "The Merchant of Venice," or perhaps "The Taming of the Shrew." These classes use only the permanent velvet hangings of the stage as a background, their imaginations supplying the costumes and properties which belong to the play.

For assembly plays, as well as for the plays which are given at Christmas and other special occasions, the stage is set simply but artistically, with a combination of the neutral hangings and a set of flats. For the stage is supplied a set of scenery which harmonizes so well with the velvet cyclorama that its windows, doors and arches may be used in a variety of ways. This set is strong but light enough so that the eighth grade boys can handle it without difficulty.

For all plays given by the school, a staff of boys chosen by the dramatic teacher and trained by the production manager, act as stage crew and electricians. Positions on this staff are eagerly sought and only the most reliable boys can hope to win a place on it.

Occasionally, the dramatic department sponsors an outside performance such as a marionette play. "The King of the Golden River" was done in the Haven auditorium lately by the Tatterman Marionettes, and the children came from all over town in such numbers that all the side doors had

THE AUDITORIUM FOYER



"THE BIRTHDAY OF THE INFANTA"—THE OPENING PRODUCTION IN THE AUDITORIUM

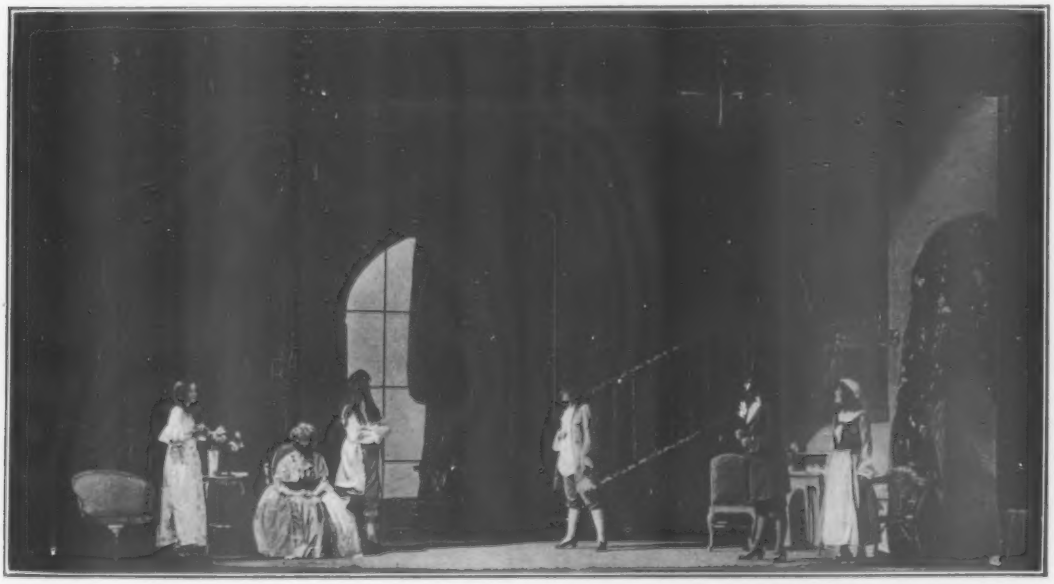
to be opened to provide enough seating space. The children of the Dramatic Department took almost entire responsibility in conducting the entertainment, and though the admission price was very low, they cleared $140 for their costume fund.

The Mechanical Equipment

Since the necessity for a completely equipped auditorium stage has been so obviously established in recent years, it is important that the best possible means be discovered for adapting the mechanics of the professional stage to the more varied demands of the school.

The stage in the Haven School in Evanston, Ill., represents an important step toward making the school stage easily adaptable to the simplest platform use or the most elaborate requirements of the drama. All strictly school affairs on the stage are managed by regular stage crews of seventh and eighth grade children, while semi-professional production crews find the equipment sufficient for spectacular plays and revues.

Those features of the Haven stage which most strongly recommend themselves are: the plastered back wall for use on a sky cyclorama; four sets of close-in curtains on noiseless track; adjustable teasers and borders; counterweighted light-battens; Pevear revolving concert borders; 18-



"THE MAKE-BELIEVE GENTLEMAN"—GIVEN IN THE AUDITORIUM

foot tormentor pipes (with steps) for spot-lights; and three 1,000-watt apron spots in the auditorium controlled from the switchboard.

School stages of today undoubtedly demand a 30- or 34-foot proscenium width, with at least an equal amount of space divided between the two wings for stacking scenery, for entrances, chorus, props, masking, etc.; (no stage intended for the use of the drama should ever be built with less wing space than playing area); they require a stage depth equal to the width of the proscenium opening and a fly-space sufficient to take full drapes out of sight. Wall lockers are needed in the wings for taking care of portable lighting equipment and cable, and at least one very wide door, 8 feet high, should be placed where it is most convenient to bring in scenery and large props.

The Haven portable lighting equipment consists of an almost ideal installation, at a cost of something less than $1,000:

10 yoke type 1,000-watt baby spots with beam directors
2 2,000-watt super-brilliants
4 1,000-watt floods
2 strips of sectional borders
8 high stands
1,000 feet of stage cable

Any of these units may be used on the teaser battens, the tormentor pipes or on the floor stands, as required; they may be plugged into the wall pockets, floor pockets, or run directly to the switchboard plugs.

Pevear three-circuit overhead eye units light the cyclorama, but, whenever possible, such illumination should come from scientifically designed strips of pans recessed in a light pit sunk in the back of the stage floor.

The commonly used disappearing footlight units are most unsatisfactory in this arrangement on account of their uncontrolled spread. Foots should be so directed as neither to illuminate the proscenium arch nor to cast shadows on the eye wall. Four-color circuits are recommended for the foots, provided with 60-watt Mazda "naturals" of red, blue, green and amber. Other circuits may be the three-light primaries—red, blue and green.

The concert border and spotlight battens should be 1½-inch pipe, hung as close to the act curtain as possible, counterweighted on the switchboard side. The forward light batten can well substitute for the tormentor pipes as spotlight hangers, if five-foot pipe be dropped from elbows at the ends of the light batten. Strips of sectional borders which take gelatine slides can be advantageously used on low stages in place of concert borders.

At the Haven School this entire equipment is controlled from a compact, flexible switchboard especially designed and built for this stage. It provides for the control of two circuits by each dimmer plate, insures against double-loading of dimmers and automatically prevents overloading of circuits of lower wattages, while allowing for the greatest flexibility of manipulation throughout.

The scenery, which was built and painted in the Northwestern University Scene Shops, is constructed in interchangeable units of varying width flats, arches, steps, parallels and flat forms, splashed so as to "take" any combination of colors thrown upon it. This has done away with the necessity of much special painting and building, even in the wide variety of plays, backgrounds, entertainments and even social affairs, for which it has been used during the entire year.

The Children's Theater

It is the Children's Theater that uses the stage to its best advantage. For Evanston has had a large and successful Children's Theater for three years, and when the Haven School was completed, the productions were brought here from the University theater. The project is sponsored by the public schools and the Parent-Teacher Association, in connection with Northwestern University School of Speech. Large and artistic productions of four worth-while plays are given each season, with four performances of each play, on two successive Saturday mornings and afternoons. In these productions, the stage is tested to its utmost, the Children's Theater plays being distinctive for the loveliness of their setting and lighting

The Children's Theater has several objects, one of which is to provide a high type of recreation for North Shore children, thus training them to be discriminating in their choice of amusements. They are planned also to supplement the dramatic courses in the public schools. The courses give the children an outlet for their own dramatic expression; the Children's Theater plays serve as model and inspiration for their work.

The policy of the Children's Theater is to have children play the children's parts in the plays, and dramatic students from the University act the adult parts. This makes possible far more convincing and artistic performances than if the children played all the parts.

The theater is directed by the dramatic supervisor in the public schools, who is also a faculty member of the School of Speech. The production manager is an instructor in production in the School of Speech and the work of managing the plays, constructing the settings, making the costumes, and acting as stage staff is a part of the work of students in the Dramatic Department of the School of Speech. The Mothers Clubs of the school conduct a campaign to sell season tickets at the beginning of the year.

Public school children have a large part in every performance by furnishing the music between acts. The Haven School orchestra is the regular Children's Theater orchestra, playing at all of the sixteen performances of the year.

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Auditorium Seats—American Seating Co.
Drinking Fountains—The Halsey W. Taylor Co.
Flooring Materials—Bonded Floors Co., Inc.
Heat Regulating System—Johnson Service Co.
Lighting Globes and Fixtures—MacBeth-Evans Glass Co.
Projecting Equipment for Moving Pictures—National Theatre Supply Co.

ENTRANCE AND SIDE VIEW OF THE AUDITORIUM

The Richard J. Reynolds Memorial Auditorium of the Richard J. Reynolds High School at Winston-Salem, N. C.

BY CHARLES BARTON KEEN

ARCHITECT, PHILADELPHIA, PA.

THE city of Winston-Salem, formed by the combination of the old town of Salem, a Moravian settlement in North Carolina of the eighteenth century, and the modern city of Winston, is principally located on hilly ground, falling on the westerly side to a broad valley. On the opposite side lies a hilly eminence of about 23 acres surrounded by wooded areas of fine trees.

This site was selected by the School Board as a suitable location for the new High School—far enough removed from the noises and disturbances of a modern city to afford a quiet and secluded spot for educational purposes. The selection of the location was largely due to the vision and foresight of the late Mrs. Katharine Reynolds Johnston, the widow of Richard J. Reynolds, for whom the High School group was named, and as a memorial to him the ground was purchased and the Auditorium was presented to the High School and the city by this public-spirited woman.

It was Mrs. Johnston's plan that the building should serve a double purpose, namely, as an auditorium adapted to the uses of a large high school, and as a civic auditorium, for the presentation of good music, plays and educational features for the enjoyment and education of the citizens in general. This double purpose demanded a practical theater design, with full stage equipment, including the latest-designed fly galleries, gridiron, scenery, lighting equipment, a seating capacity of about 2,200 and an architectural treatment of quiet and restful dignity.

The first floor was designed to hold the average auditorium attendance of the High School, of about 1,000, and as the school grows in size, the balcony also will be used.

The Auditorium constitutes the central building of the group, the Academic Arts Building being located on one side and connected from the first floor by a partially above-ground and

GENERAL INTERIOR VIEW OF THE AUDITORIUM

partially under-ground passageway to the basement of the Auditorium, from which convenient stairways lead to the main floor. The future Household and Industrial Arts Building, to be erected in a year or two and balancing in design the Academic Arts Building, will be built on the opposite side and connected to the Auditorium in a similar manner.

On the Household and Industrial Arts side of the Auditorium there is a one-story wing, containing the music and choral instruction rooms, consisting of a band or orchestra room, a choral room, music practice rooms, and a library and director's office. On the opposite side it is planned to build the Administration Wing, at present housed temporarily in the Academic Arts Building, containing general and principal's office, medical and dental clinics, dressing-rooms, rest room, book room, etc.

The architectural style of the group is Georgian, the materials being Colonial brick with Indiana limestone cornices, columns and other trimmings. The Auditorium is a building 172 feet in length and 100 feet in width, and is equipped with stage dressing-rooms, property rooms, lobbies, foyers, men's and women's rooms, and all other features of a well-designed and equipped theater building.

Especial care and study were given to the sight lines, affording every seat a full and unobstructed view of the stage, and to the acoustics, with the most remarkable success, as attested by every one speaking or playing in the building. An ordinary conversational tone of voice on the stage is readily heard in the most remote seat of the Auditorium.

PRINCIPAL TYPES OF EQUIPMENT INSTALLED

Acoustical Equipment—Johns-Manville, Inc.
Auditorium Seats—General Seating Co.
Blackboards—Pennsylvania Structural Slate Co.
Boilers—Kewanee Boiler Co.
Clocks and Signal Systems—Stromberg Electric Co.
Drinking Fountains and Plumbing Fixtures—J. L. Mott Iron Works.
Heat Regulating System—Johnson Service Co.
Projecting Equipment for Moving Pictures—International Projector Co.

Supplies—Their Purchase and Distribution*

BY J. S. MULLAN

SECRETARY AND PURCHASING AGENT, BOARD OF EDUCATION, ROCHESTER, N. Y.

ALL purchases should, I believe, be made as far as possible on the competitive basis; and in order to secure the best results, carefully prepared specifications should be made. Before preparing such specifications, a survey should be made of all materials in use in the schools at the time, to ascertain whether they are giving entire satisfaction and, if not, what just criticism can be made by the teaching force.

Purchasing agents should keep in touch with the supervisory force, heads of departments and others to whom is delegated the authority to make changes in textbooks or suggest changes in the curriculum affecting textbooks or other materials, and a definite understanding should be reached that notice must be given to the purchasing agent far enough in advance of any contemplated changes to permit him to dispose of materials then on hand. When specifications have been prepared, bids received and contracts awarded, it should also be understood that no changes by any department should be made until the materials already purchased have been exhausted. This is by no means one of the least essentials for avoiding the stocking of shelves in the central storehouse with dead material.

In large cities, at least, there should be a central depository; this makes possible the purchase of supplies in large quantities at correspondingly low prices. Furthermore, it insures more prompt deliveries, as well as uniform materials or products to all schools—both main essentials in meeting pupil needs. We must bear in mind at all times that the pupil is our chief concern and should be given our first consideration.

Uniform Specifications

There is no such thing as uniform specifications, for the reason that specifications must be prepared to meet local regulations in the various states. In New York State, for example, the law requires that a contract must be awarded to the lowest responsible bidder, making it necessary for us to safeguard our specifications in order that we may secure the proper quality of materials. We therefore choose as a standard a certain make of material or a manufacturer's name representing the quality that we desire, and so stipulate in our specifications. In other words, were we to advertise for drawing pencils and not use as a standard John Doe's No. X as to quality, we should be required to accept the lowest bid regardless of quality. We do not, however, hold arbitrarily to the description as contained in our specifications, but give the bidder the privilege of submitting bids on substitutes, in which case he is so to state, mentioning the particular item to which the statement refers. Price and quality in this case are determining factors.

Care should be exercised in the preparation of the specifications as to the use to be made of the material. If, for example, a lesson is to be given using pencil or ink paper and after the lesson is over the paper is immediately destroyed, the cheapest possible paper available to stand the test should be purchased. On the other hand, where a lesson is given requiring the retention of papers, better quality should be furnished. This question of use should be the determining factor in purchase all along the line.

Securing Bids

After specifications are prepared and bids called for, the purchasing agent should refer to his up-to-date file (of course, every purchasing agent should keep one), containing the names of all reliable vendors handling the various items as contained in said specifications. A copy of these specifications should be mailed to each vendor, or at least notice should be given him that bids are called for and specifications may be secured at the office of the purchasing agent. Too much emphasis cannot be laid upon the importance of securing the largest number of competitive bids, and only by keeping an up-to-date file can this be brought about satisfactorily.

Tabulating sheets should be prepared conforming with specifications as to items, so as to facilitate and save time in tabulating. When bids have been opened and tabulated, the real work of the purchasing agent begins. Consideration should be given in each case to the lowest bidder. If the quality meets the specifications, there is no problem. Should it not, then the next low bid should be given the same consideration, and so on until the specifications are met. Other things being equal, local dealers should be given the preference in the awarding of contracts, but out-of-town bidders should receive due consideration, and if their bid is low, and meets specifications, they are entitled to and should be awarded the contract. It is not fair to solicit competition and then eliminate out-of-town bidders. On the other hand, if we state in our specifications that only local dealers can bid, there is a danger that we may receive higher bids than if these bidders knew they had to meet outside competition.

* From a paper presented at the Denver Convention of the National Association of Public School Business Officials, June, 1928.

The purchasing agent should not be the sole determining factor in making the choice of materials. He should take into his confidence committees consisting of supervisors, heads of departments or others concerned with the use of the materials, and secure their judgment as to quality. This does not necessarily mean that the judgment of such committees need be accepted as final, but the fact that people concerned with the use of materials have had a part in discussions relating to their purchase will often forestall criticisms of the quality of such materials later. After a satisfactory decision on materials has once been reached, it should be considered final for the entire system—that is, the material accepted should be used in all schools. Were we to permit one person his or her preference and another something different, it would be necessary to establish a storeroom for each school and prepare separate specifications.

Samples Required

It is essential that samples be submitted with the bid, except in cases where bidders are bidding on and agree to furnish exactly the make or name of the article designated in the specifications. When samples are submitted and accepted, they should be properly tagged, placed under lock and key and retained until delivery of material is made to the storehouse. A careful comparison should be made of each item with the sample submitted. If materials delivered do not meet specifications, then a readjustment is demanded.

Checking

The checking of the goods received at the storehouse is a matter of no small importance. In case the person checking up material finds an amount different from what should have been received, he should require a separate count made by another individual in the stockroom and should not reveal to him his findings until after the second count has been made. If the two agree, it is quite evident that there is an error in the delivery. In case, however, their count does not agree, a third person should be called in to make a recount. to be absolutely sure before a report is made.

Janitors' Supplies

The selection of cleaning supplies is a real problem. Some time ago, after consultation with our supervisory janitor and stockkeeper, we deemed it wise to have an investigation made as to the quantities of cleaning powders being used, feeling that a saving could be made. In canvassing the matter, our belief was confirmed. In order to arrive at a solution, we counseled with a few of our best janitors and decided as a tryout to choose one school whose janitor's opinion would be reliable as to results. We then took some of the more expensive powders and requested him to try them out, reducing quantities to the minimum necessary to get desired results.

This was done and it was clearly demonstrated that in many cases the cheaper powder was the more expensive in the long run and that we were using a greater quantity than needed. We then called a meeting of the janitorial force. The matter was presented to them with an explanation of the results of the demonstration as to the reduced quantities. Many of them replied, "It cannot be done." We requested that they give it a trial, which they did, in a very cooperative spirit. Most of them were honest enough to come later and say, "We found that you were right." We then standardized upon the amounts necessary to do the required work and are dealing out our janitorial supplies accordingly. This does not mean that we are purchasing the highest priced materials. We also analyze cheaper materials in order to determine the best results obtainable for the least money. We find that the amount of material used has been greatly reduced, with a considerable corresponding saving.

Deliveries

Under our present system we figure on four deliveries of supplies per year—two each twenty-week semester. Emergency requests, of course, are given due consideration and deliveries made when necessary. Deliveries are made from requisitions signed by the principals of the various schools on a per pupil basis. In other words, instead of filling in the amounts that are needed for each teacher or department, principals simply furnish the number of pupils registered, and give an inventory of supplies on hand. All requisitions must be signed in ink by the principal and sent to the purchasing agent for his approval. The purchasing agent then passes them on to the chief clerk in his department, whose duty it is to see that they are filled out as to quantities and that the material is marked and made ready for distribution. Each teacher has a separate blank for her requirements and fills in, as stated above, her registration and inventory figures only. It does sometimes happen that a teacher may not use one or more of the standardized items. For such cases we allow the code sign (X) which means "Do not use." A column is provided on the blank in which to insert the code.

The requisitions in triplicate are now passed on to the central storehouse. The first copy is retained at the central storehouse, the second copy goes to the price clerk, and the third is sent back to the teacher for a check-up. In filling these requisitions at the central storehouse, a recount is made of each item by two people in order to verify the count, and the material is then put in cartons or otherwise wrapped and marked "Mrs. Jones, Room No. 32, School No. 76." The goods are delivered by our own trucks. Packages are receipted for by the principal or some person delegated, by merely recording the number of packages delivered. The janitor or some one designated by the principal sees that the packages are placed in the rooms as marked. The teacher is furnished

with a copy of the contents of each package, which is checked by her and returned to the central storehouse. Should a shortage occur, she reports it.

We have received only favorable comments from the teachers on the handling of their supplies in this way. They claim that they can plan their work better by having a ten weeks' supply in their possession rather than by being required to requisition from time to time through the principal from a general storeroom in the building. We find beyond doubt that a great saving has been effected, for the reason that not only teachers but pupils have been more careful in the use of supplies. The pupils, for instance, are given to understand that a certain amount of supplies is furnished and that they must exercise the utmost economy in the use of these supplies. I hear some one say, "You are handicapping the teacher who perhaps may be a little more progressive than others and because of her enthusiasm requires additional supplies." This may be true. All that it is necessary for such a teacher to do is simply submit the facts through her principal or supervisor and, if approved by them, the required amount of extra supplies will be furnished.

Unless proof of this kind is furnished, there is no reason why where conditions are absolutely the same in one school as in another, one teacher in any particular grade should require more material than another in the same grade. It is not our purpose to handicap a teacher by scrimping material. In arriving at our standardized quantities we considered very carefully the danger of reducing the amount of material furnished to a minimum, but we find that the quantities furnished are satisfactory and the teacher's inventory prevents the accumulating of much surplus.

Purchase Orders

Inasmuch as certain materials cannot be carried in the central storehouse to advantage, it becomes necessary to issue purchase orders. Special blanks are prepared upon which the principals are to make such requisitions. The orders are issued in quintuple, consisting of different-colored paper. One copy is sent to the vendor. Three copies are retained in the purchasing department, one of which is priced and passed on to the finance department to give the daily expenditure and enable this department to control the budget limitation. The fifth copy is sent to the school from which the requisition has been received. This enables the principal to know that his requisition has been honored and with whom the order has been placed. He retains his copy and as soon as delivery is made by the vendor, he, the principal, receipts this sheet and sends it to the purchasing department. If one or more items should not have been delivered, he sends in his copy just the same, but checks off whatever has been received. In such cases the extra copy retained in the purchasing agent's office is mailed to the principal, giving the unfilled item or items, and this copy he holds until the completion of the shipment. By following this procedure there is no delay in the payment of vendor's bills by holding them for complete deliveries. In case the principal retains this last sheet for a reasonable time (twenty days at the longest) and non-delivery of order occurs, he is then expected to make a report relating the facts to the purchasing department.

It should not be the duty of the purchasing agent to determine whether the articles requisitioned on purchase orders should be bought. It is not his job to pass judgment on materials other than on regular stock, as in many cases the need of such material ordered might be due to a change in policy, and the only person who can intelligently pass on such order is the one most familiar with the situation. The superintendent of schools should delegate either the assistant superintendents or heads of departments to pass judgment on requisitions of this nature. After their approval is affixed, the requisition should then come to the purchasing agent, whose duty it is to use his best judgment in making the purchase, regardless of whether the requisition bears the notation that it is to be bought from John Doe. A purchasing agent who is faithful in the performance of his duty should through experience be in a position to effect a better bargain than those not having experience along this line.

Teachers and others who are required to make out requisitions should thoroughly understand that they should not bargain with agents. It is embarrassing to have an agent call on the purchasing agent and inform him that a requisition is expected from Mrs. Jones of School No 92, which would indicate that this agent has had an interview with Mrs. Jones. Negotiations leading to purchase should be made only through the purchasing department.

Confirmation Orders

Permission should never be given to the principal or any other person outside of the purchasing department to place orders by telephone, intending to send in a requisition bearing the notation, "John Doe, confirmation order." If permitted to do so, too often such persons will neglect to send in the requisition, and months after, when the bill is presented to the purchasing agent's department for checking, there is no record of the order's having been placed. Confusion arises and considerable time is required to adjust the matter. When such a bill is received and the person who unofficially placed the order is located, he or she should be required to pay the bill as if the material was ordered for his or her personal use.

It is true emergency cases will arise where immediate attention is required, these usually being requests for urgent repairs. In such cases the principal should call the purchasing department on the telephone, state the facts, and dismiss the problem from his mind excepting for the making of a report when the work has been done or the materials delivered. The purchasing agent can place the order by telephone, and the person with

whom the order is placed is given an order number and advised that he will receive the order in the next mail. In this way, and in this way only, can an exact record be kept of all outstanding accounts.

Securing Prices

When purchases are made for material other than that carried in the central storehouse, prices should be received from at least two or three reliable dealers. This, of course, applies to amounts, say, above ten dollars and up to the limit at which purchases can be made without advertising, as covered by local laws. There are instances where it is impossible to secure competition, for example, if a certain make of typewriter were to be purchased and no other make could be used, we should be at the mercy of the vendor and he could fix the price to his advantage. It is policy, however, even in cases of this kind to call for prices to be submitted, which would lead the vendor to believe that unless his price was attractive he might lose out.

Inventories

Inventories should be taken at least once a year of all materials in the schools and a proper record kept. The stockkeeper's records should reveal at all times a perpetual inventory of the amount of stock on hand.

The purchasing department should establish a minimum amount of all supplies to be carried at all times in the storehouse. It is the duty of the stockkeeper to notify the purchasing agent when the stock is depleted to the minimum amount; that is, should the minimum amount of chalk be fixed at fifty cases, when it reaches this amount immediate notice should be given to the purchasing agent so that a re-order may be made at once to avoid shortage, and thereby delays in delivery.

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DESK TYPE

Coupled with their extreme simplicity — the user merely pushes a button to make the desired connection—Graybar Inter-Phones are reliable in the extreme. Associated with them is over a half century of experience in the supplying of telephones and telephone equipment. In addition to this, the longest record of service in the field of sound transmission, are the high precision standards to which Graybar Inter-Phones are built and tested.

ITS RECORD

The most conclusive proof of the high quality of Graybar Inter-Phones is their performance in actual service. Inter-Phones have been installed in all kinds of schools and colleges from coast to coast, rendering in every case satisfactory service.

WALL TYPE

Inter-Phones are made in various styles to meet a wide variety of requirements. On this page are shown two such styles. One is the wall type; the other is the desk type.

The selection of the proper type of Inter-Phone is considerably simplified by the large amount of information and experience records available. Graybar Inter-Phone specialists will be glad to place this material at the disposal of architects and school boards.

LIGHTING

That which in commmercial fields is largely a financial consideration becomes sometimes in educational work, a matter of serious importance bearing on the physical and mental progress of many individuals.

THE LINCREST

Proper lighting, in schools, is a great factor in conserving the eyesight of growing youth and in accelerating the rate of progress of the student.

Approached from that angle, Graybar's complete line of scientifically designed lighting units assumes considerable significance.

Foremost among these is the Graybar Shelcrest. Here is a distinct advance in lighting fixture practice. To begin with, its stem is entirely of Bakelite, which, aside from the practical consideration of extreme ease of cleaning, gives the entire unit that conspicuous warmth, richness and trimness of finish characteristic of this material. The stem comes in sections, permitting ease and flexibility of installation. The globe is held by a patented safety device.

Another popular Graybar lighting unit is the Lincrest. This fixture, also a safety type, combines simple beauty of design, correct electrical and illumination characteristics and highest grade of material and workmanship.

Among other types of Graybar lighting units are the Stancrest (which varies from the Lincrest chiefly in that the globe is held by set screws) and the Faircrest (an even more economical unit, typical in every way of Graybar quality).

All these units are available with the famous "99" or "66" glass, or with special glass to suit individual requirements.

THE SHELCREST

MANY SUCCESSFUL INSTALLATIONS

Among the many successful installations of Graybar lighting units are the following:

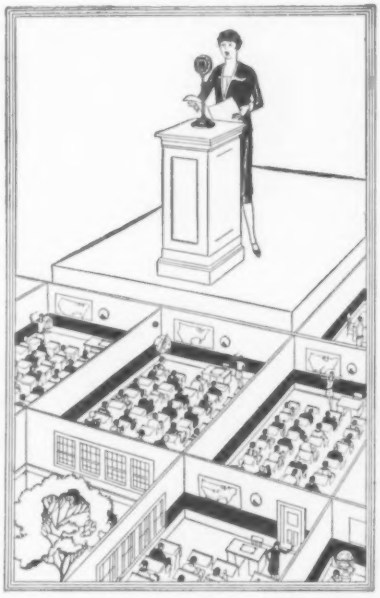
Kansas City School	Kansas City, Mo.
Frazier School	Atlanta, Ga.
William Ruffner School	Norfolk, Va.
Eau Claire High School	Eau Claire, Wis.
City Schools	Gary, Ind.
Belmont School	Dayton, Ohio
Park City School	Knoxville, Tenn.
Garfield High School	Johnstown, Pa.
Marquette University	Milwaukee, Wis.
University of Wisconsin	Madison, Wis.
Virginia Polytechnic Institute	Blacksburg, Va.
Asheville City Schools	Asheville, N. C.
Syracuse University	Syracuse, N. Y.
Tulane University	New Orleans, La.
Public Schools	Buffalo, N. Y.
Spokane Public Schools	Spokane, Wash.
Marietta High School	Newark, N. J.
New Central High School	Johnstown, Pa.
Foch School	Detroit, Mich.
North Carolina State College	Raleigh, N. C.
Ohio State University	Columbus, Ohio
Massachusetts Tech.	Cambridge, Mass.
Colorado Agricultural College	Fort Collins, Colo.
University of Minnesota	Minneapolis, Minn.
University of Illinois	Champaign, Ill.
Rosary College	River Forest, Ill.
Purdue University	Lafayette, Ind.
College of the Pacific	Stockton, Calif.
Hazleton High School	Hazleton, Pa.
Piedmont Junior High School	Charlotte, N. C.
Villa Juliene High School	Dayton, Ohio
Butler High School	Springfield, Ohio
Grovefoot School	Columbus, Ohio

PUBLIC ADDRESS SYSTEMS

A new and striking development in educational equipment has come to the fore in recent years.

It is the Western Electric Public Address System; and its installation permits the distribution of speech and music to any or all parts of the school building at once. Its most conspicuous applications are as follows:

1. Transmitting fire drill instructions. (In actual emergency value alone, a sufficient justification for the system.)
2. Conveying the principal's morning address to all rooms at once.
3. Transmitting music from the auditorium or from the music teacher's station to any desired rooms.
4. Transmitting gym instructor's commands to all rooms.
5. Conveying a visitor's, or a special instructor's, speech to all parts of the building.
6. Receiving and transmitting educational radio programs (such as the Damrosch Concerts) to all rooms.



A GRAPHIC INTERPRETATION OF THE MANNER IN WHICH THE PUBLIC ADDRESS SYSTEM UNITES A SCHOOL AS IF ALL CLASSROOMS WERE ONE

In short, the system brings the largest school together as if all classrooms were one. Many other uses along these lines will suggest themselves; this by no means would cover the entire range of usefulness of the Public Address System. There is, for example, its other function of amplifying speech so that the youngest child's voice, speaking on the auditorium stage, can be heard in the farthest corner of the hall.

THE TEST OF ACTUAL PRACTICE

So fundamental is the use of the Public Address System that its use has already become quite widespread. One school after another has installed it, with a resultant increase in interest in the work on the part of both teachers and students.

A QUALITY PRODUCT

The Western Electric Public Address System is essentially a quality product. It is made by the makers of the nation's telephones—the greatest, and the oldest organization of sound transmission equipment experts with an experience that dates back to 1869.

The distributors of Western Electric products, Graybar Electric, offer to school executives and architects the benefit of its experience accumulated through contact with a wide variety of school, public building, hotel, hospital and other installations.

AMONG THE MANY SCHOOL INSTALLATIONS ARE

San Jose High School, San Jose, Cal.
Monroe High School, Rochester, N. Y.
Drexel Institute, Philadelphia, Pa.
University of Idaho, Moscow, Idaho
Tuskogee Normal Institute, Birmingham, Ala.
Western Reserve University, Cleveland, Ohio
Fullerton High School, Los Angeles, Cal.
South Orange and Maplewood High School, N. J.
Little Rock High School, Little Rock, Ark.
St. John's College—School of Law, Brooklyn, N. Y.
Ohio State University, Columbus, Ohio
New Jersey State College for Women, New Brunswick, N. J.
Webster Junior High School, Oklahoma City, Okla.
University of Washington, Seattle, Wash.
University of Utah, Salt Lake City, Utah
Kruttschnitt School, New Orleans, La.
LaSalle School, New Orleans, La.
Washington High School, Milwaukee, Wis.
Hollywood High School, Los Angeles, Cal.

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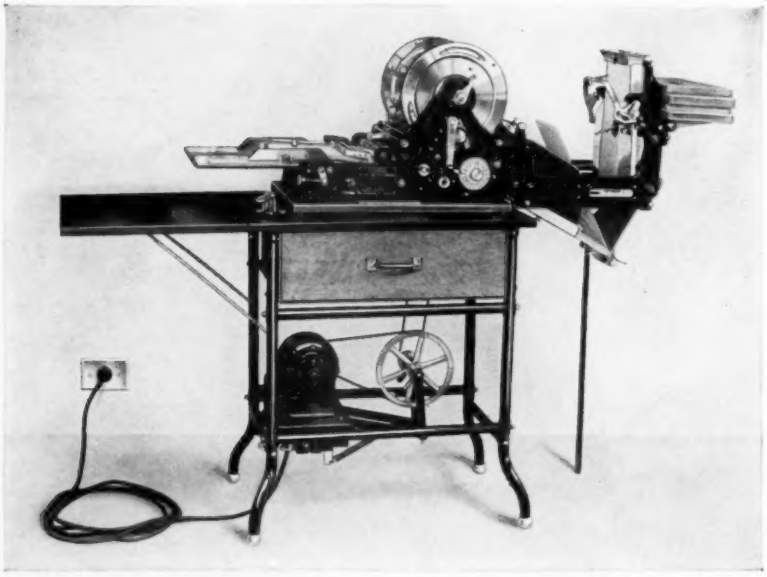


MIMEOGRAPH NO. 78B WITH AUTOSLIP AND MOTOR DRIVE

THE MIMEOGRAPH PROCESS

The Mimeograph Process is the simplest, quickest and least expensive method of printing. The subject matter is written by a typewriter or stylus on the stencil sheet, through which a thin filament of ink is pressed from the ink pad to the impression paper as it passes between the revolving cylinder and the impression roller. The even, clear-cut, faithful impression is remarkable, but the speed with which impressions are made—several thousand an hour—is even more remarkable.

THE MIMEOGRAPH

The Mimeograph pictured above sets "the high-water mark" for duplicating machines. It has an automatic feeding device, motor drive, and the closed cylinder with improved inking system which is highly efficient and economical, and removes from the Mimeograph all thought of mussiness.

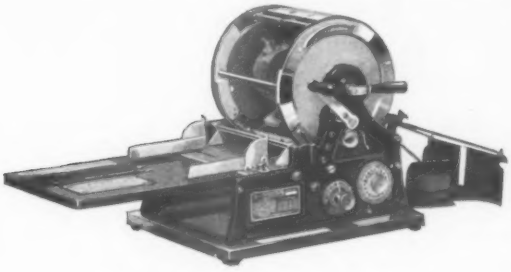
The Mimeograph finds work in every department of school activity—instructions to teachers, examination papers, drawings, maps, music, school newspapers, bulletins, ruled forms, programs, supplementary textbooks, etc.—all can be reproduced easily and quickly, at a great saving.

The impression sheets may be fed by hand if desired, and the machine can be furnished without the Autoslip or motor drive.

THE AUTOSLIP

The Autoslip interleaver is at once a simple and an ingenious device for interleaving or "slip-sheeting" Mimeograph copies to prevent ink offsetting on the back of succeeding sheets.

No additional power or effort is required—all that is necessary is to keep the feedboard supplied with paper and the Autoslip with slip-sheets. The speed is equal to the Mimeograph with which it is in exact time.

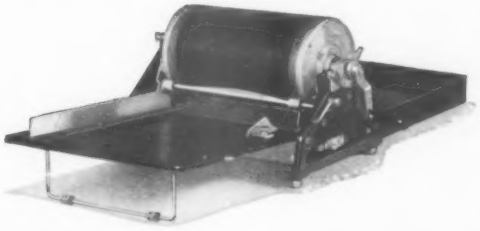


MIMEOGRAPH NO. 77A

Operated entirely by hand. This model may also be had with an automatic feeding device, for the convenience of the user having a larger volume of duplicating; also with motor drive.

The Model A Mimeograph is provided with an ink fountain and brush hung in the open printing cylinder from which the ink is quickly and easily distributed.

Both A and B Model Mimeographs take paper up to 9 by 16 inches; actual maximum printing surface 7¼ by 14 inches.



PORTABLE MIMEOGRAPH NO. 72

A complete, practical, cleanly, compact and speedy Mimeograph for the moderate user.

Works on same general principle as standard size Mimeographs. Has closed cylinder inking system—takes paper up to 8½ by 11 inches—and can be operated at a speed of 45 or more copies per minute.

ASK FOR

"The Mimeograph—The Teacher's Most Able Assistant"

AND PRICES

THE AMERICAN SCHOOL AND UNIVERSITY

PICTURE MAKER FOR THE MIMEOGRAPH

NO. 1 MIMEOSCOPE

(With Tiltoscope)

Pictures speak a universal language and convey ideas most forcefully. The No. 1 Mimeoscope is a drawing table with an electrically illuminated top, making possible the tracing of drawings of any nature (mechanical or freehand) on Mimeotype stencil paper.

Constructed of metal, with frosted glass drawing plate in wood frame; revolving metal base, adjustable to any position of work.

PORTABLE MIMEOSCOPE

A simple tracing table designed for stencil work and capable of being illuminated by reflected daylight or by electric light. It will permit tracing or drawing directly on Mimeotype stencil paper of an extended variety of designs and forms suitable for reproduction on the Mimeograph. It is also well adapted for proof reading stencils.

C. S. HAMMOND & COMPANY, INC.

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General Offices and Manufacturing Department

60-62 FRANKLIN AVE., BROOKLYN

THE NEW WORLD LOOSE LEAF ATLAS

The world is ever moving, changing, progressing. Each passing month leaves its mark upon the map. New cities are born; new counties are created; even new nations sometimes spring into existence. Railroads extend their lines; new water routes are opened; new lands are discovered, and every change makes the old-fashioned, permanently bound atlases more and more out of date, less and less accurate and dependable.

The New World Loose Leaf Atlas is not bound in the old-fashioned way. It is in reality a collection of maps held firmly together by a loose leaf binder from which individual maps, when they become obsolete, may be removed and replaced by new ones.

It is generally recognized that maps have become indispensable in business, in school, and in the home. They are essential to complete understanding of the newspaper dispatches we read each day and of the great international questions which are constantly arising. The maps, however, must be down to date and complete, otherwise the false impressions will result in worse confusion than if no maps at all were consulted. Since bound atlases become old within a few months after their purchase, the New World Loose Leaf Atlas alone provides a satisfactory, convenient and economical solution.

Each owner of the Atlas receives twice a year sets of Correction Maps to be inserted in his Atlas in place of the old ones which have become obsolete through recent changes. These maps are printed on single pages, uniform in size with those in the Atlas, so that when they are inserted, the book is as complete and down to date as on the day of purchase.

Not only is the New World Loose Leaf Atlas under constant revision and improvement but it is TO-DAY

THE BEST AND LARGEST COLLECTION OF MAPS MADE IN AMERICA.

The superb examples of cartography embrace the whole world, correctly and exhaustively. Briefly, the collection may be itemized as follows:

58 Physical and Economic Maps
184 Political Maps of Foreign Countries
78 Historical Maps
70 Detailed Maps of the United States

THESE ILLUSTRATIONS SHOW HOW VERY EASY IT IS TO REVISE THE NEW WORLD LOOSE LEAF ATLAS

1ST. CORRECTION SHEETS ARE MAILED TO THE SUBSCRIBER TWICE A YEAR. HE RELEASES THE SCREWS AT TOP AND BOTTOM OF THE BINDER BY MEANS OF A SILVER COIN, AS ILLUSTRATED

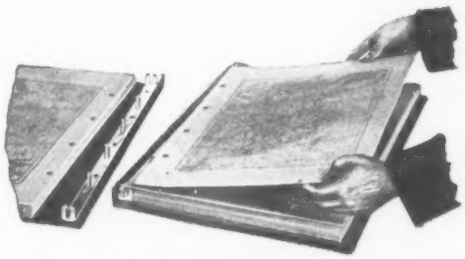
2ND. AS SHOWN ABOVE, THE FRONT COVER MAY THEN BE EASILY REMOVED AS WELL AS THE MAPS WHICH ARE TO BE REPLACED WITH NEW ONES

GRAPHIC PICTURES OF ACTUAL CONDITIONS

The Physical and Economic maps are full of vital information, enabling one to visualize existing conditions in all parts of the globe. The maps show relief, climate, temperature, vegetation, population, mining and agricultural products, and many other phenomena.

THE WORLD IN MAPS

The maps of Foreign Countries show the world as it is today. Every country is shown on large scale and in great detail. For instance, five pages of maps are devoted to France, three to China, seven to South America, nine to Canada, etc. These maps show the mountains and hills in gray, water areas in blue, railroad routes in carmine, the political boundaries in tint, and the names of political subdivisions, places and topographic features in black.



3RD. THE CORRECTION SHEETS MAY THEN BE INSERTED IN THEIR PROPER PLACES AS SHOWN ABOVE. THE COVER IS REPLACED, THE TWO SCREWS TIGHTENED AND—

HISTORY IS GRAPHICALLY TOLD

on the 78 Historical Maps in the New World Loose Leaf Atlas. This series of maps will enable you to trace the whole course of events from ancient times to the present day.

THE MAPS OF THE UNITED STATES

are exceptionally fine ones, being engraved on large scales with a vast amount of detail. Many of the states are shown on double page plates. With very few exceptions, these maps show every post-office and railroad station in the country, as well as all countries, rivers, reservoirs, parks, etc. Every mile of railroad, both steam and electric, is shown.

COMPLETE AND USABLE INDEXES

The index of each map appears on the pages immediately preceding and following the map, so that a place may be located quickly by means of the index references. The indexes include every county, or other minor sub-division, city, town, village, and hamlet with latest population figures.

THE 390 MAPS IN THE ATLAS

vary in size but most of them measure 11 x 18 inches. The pages are uniformly 13½ x 19½ inches and have four holes punched along the inner edge, to fit over the posts of the binder.

4TH. THE ATLAS, REVISED TO DATE, APPEARS AS SHOWN ABOVE, THE WHOLE PROCESS OF REVISION TAKING LESS THAN TEN MINUTES, SEMI-ANNUALLY

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Universities of Arizona, Arkansas, California, Delaware, Georgia, Hawaii, Illinois, Kansas, Maryland, Minnesota, Missouri, Nebraska, New Hampshire, North Carolina, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, Washington, Wyoming, Yale, New York, Columbia, Harvard, Northwestern, Cornell, Ohio State University, Bowdoin College, Massachusetts Industrial College, University of Chicago, Williams, Vassar, U. S. Naval Academy, Oberlin College.

SCHOOLS AND ACADEMIES

High Schools in Hollywood, Cal., Stockton, Cal., South Bend, Ind., Kansas City, Mo., St. Louis, Mo., Newark, N. J., Orange, N. J., Albuquerque, N. M., Auburn, N. Y., Philadelphia, Pa., Logan, Utah, Page Military Academy, Los Angeles, Cal. Miss Porter's School, Farmington, Conn., Beverly Farm School, Godfrey, Ill., Northfield Seminary, East Northfield, Mass., Lowell Textile School, Lowell, Mass., Knox School, Cooperstown, N. Y., Dan Beard's Outdoor School, Flushing, N. Y., Franklin and Marshall Academy, Lancaster, Pa., Staunton Military Academy, Staunton, Va.

BINDING AND PRICE

The loose leaf binder is covered with handsome, red crash and stamped in gold and blue. It measures 14 x 20 inches. The price, including two installments of correction sheets, is $50.00.

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In Remington Rand are grouped vast resources of methods, materials and men. This company brings together the ten leaders in the office equipment field and masses their experience beneath a single roof. They are represented in your own office by the Man from Remington Rand. You should know him intimately.

The Man from Remington Rand is not a salesman in the strict interpretation of the term. He is a specialist in office ways and means. He is a vendor of ideas, his own, his company's and his client's. These ideas he adapts to the requirements you reveal to him. And so he serves you well, because you buy from him more than machines or furniture or files.

Talk with him about the school equipment listed here.

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BEAUTY THAT ENDURES

There is no substitute for experience. Library Bureau has designed, manufactured and installed technical library furnishings for more than three decades. That experience is reflected in the beauty of line and the strength of working parts which you always find in products of L. B. make.

Tables, desks and chairs, bookstacks in wood and steel, catalog cases which build up sectionally, booktrucks, magazine racks and bulletin boards are all in the L. B. Library line.

CLASSROOM QUIET

The typewriting class that uses the Remington Noiseless does its work in an atmosphere of quiet. And it does better work on that account. Bustle and confusion are largely absent.

The Remington Noiseless has a standard keyboard. It has the light touch that makes for typing speed. Built into its sturdy frame are all the durable qualities which have been associated with the Remington name for more than fifty years. You will be pleased with the performance of the Noiseless.

A LIBRARY BUREAU CHARGING DESK

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The Kardex record is a speed record. For Kardex is visible record keeping. The filing title of every card is exposed in the Kardex cabinet. Your eye spots the one you want instantly—without a sign of fumble. Your school administrative records will be maintained more speedily and more accurately if kept in Kardex.

For the essential facts recorded on Kardex cards are also visible. Detailed reference to the body of the form is rarely necessary. Brightly colored signals, on the indexing margins of the cards, put you in command of the facts immediately. And you act intelligently because you act on-time.

THE SAFE-CABINET

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The graduate in office practice is immediately at home in an office if she knows how to file. Instruction in filing is necessarily instruction in the methods of business routine. The Library Bureau filing course ought to form a part of every school's commercial curriculum.

Students of this course learn by doing. Each uses a miniature filing system of his own. Each does the work a filing clerk would do. Each gains theory from the text and applies it by actual practice with a miniature file.

THE KARDEX CABINET

SAFETY FOR RECORDS

A record worth keeping is worth safe-keeping. Its value may be greatly enhanced after the visit of a destructive fire. Untold difficulties and loss often result from the burning of the records that schools maintain.

The Safe-Cabinet is the world's safest safe. Its ability to protect its contents against fire has been tested by fire. The results of these tests are embodied in specifications for heat resistance which may be matched against the degree of exposure to loss by fire.

THE BROOKS COMPANY

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BROOKS VISUALIZERS

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The most important factor in record-keeping is the equipment. Quickly prove this by reviewing the manner in which your own educational records are kept. Don't you find some whose efficiency and usefulness would be increased through application of better suited equipment? Wouldn't it mean considerable to be able to keep one or more of these records in about one-half the time now required? Wouldn't easier operation, greater accuracy and less clerical expense in keeping such records be well worth considering?

The Automatic Shift found only in Brooks Visualizers is the greatest time-saving device of visible record equipment. With it you can instantly create a space for a new sheet at any point in a record and in a reverse manner close a space when a sheet is removed—all without removing any other sheets. See the shift—operate it and you'll instantly realize its value to record-keeping.

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Brooks Visualizers can do these things for you and 100% visible indexing of records in compact, portable units is only part of the story.

Write for interesting booklet "Keeping Track of John Brown, Student"

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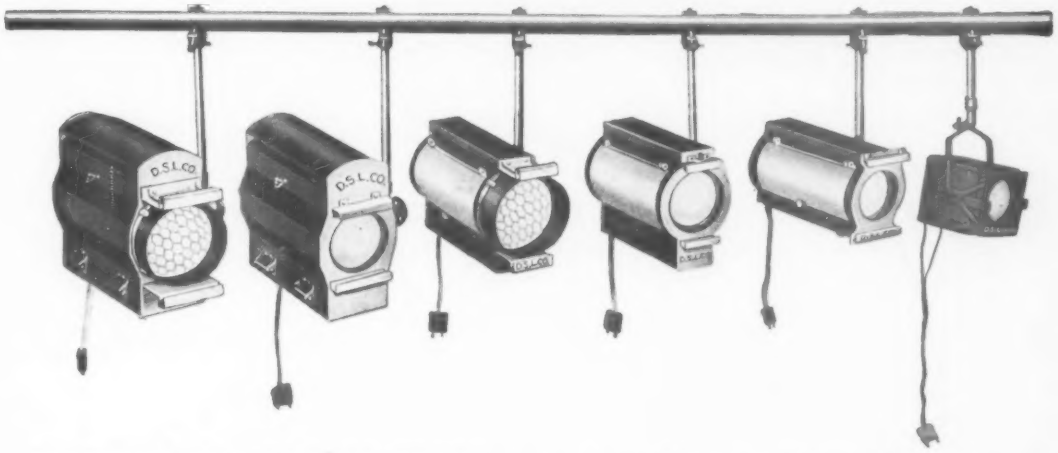


LIGHTING THE SCHOOL STAGE

School builders of today recognize the importance of including in their school plan an adequate, attractive auditorium with a good, well-lighted stage on which all kinds of school activities from dramatics to acrobatics can be presented.

Stage lighting is today accepted as a vital factor in the success of every evening exhibit, entertainment or celebration held in the school auditorium.

The **Display Stage Lighting Company,** pioneers in the art of stage lighting, have played an important part in its development. World-wide recognition of the merits of our stage lights has enabled us to grow constantly and rapidly, until today there is no demand in stage lighting that we cannot meet satisfactorily and promptly.

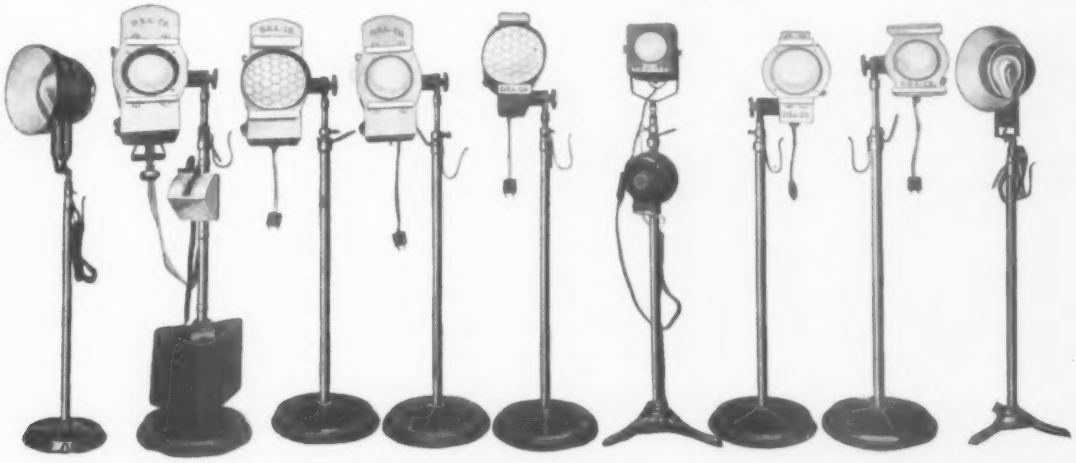
There is "A LIGHT FOR EVERY PURPOSE." No order too large, no order too small—all will meet with our prompt and careful attention.

SPECIAL SERVICE

We shall be glad to advise with you regarding any special problem of lighting that may come up in the planning of your new school auditorium and stage.

CATALOG

A detailed descriptive catalog will be sent at the request of any school board official or department head.



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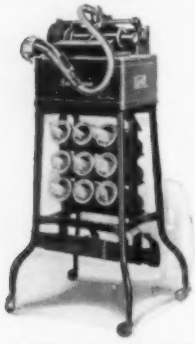
Thos. A. Edison's New Dictating Machine

The Executive Ediphone combines all the essentials of dictation convenience and facility. Executives gain time and are freed from laborious longhand for notes, memoranda, etc., and from tiresome shorthand dictation periods. Always at the desk with its automatic operation it makes of dictation an incident like telephoning.



THE EXECUTIVE EDIPHONE

The Secretarial Ediphone enables Secretaries to organize their work, to give more thought and care to each duty and to perform many duties always wanted but impossible for lack of time.

The new Ediphones are distinguished by electric control, succeeeding slower mechanical devices.

The dictator enjoys speaking conversationally and comfortably to a large mouthpiece which amplifies and clearly records the voice.

Stenographers have the voice at the finger tips with Typease, attached to any typewriter. A light tap by the thumb, like operating the spacebar, causes the voice to speak or repeat. This is ideal for the touch typist, adding speed and reducing fatigue to a minimum.

Edison's New Secretarial Ediphone

WORLD-WIDE SERVICE

Ediphone Sales and Service stations in all principal cities study correspondence problems and advise with executives without charge.

Telephone the Ediphone, your city, for particulars or ask Orange for the booklet "Getting Action." It's free.

Edison

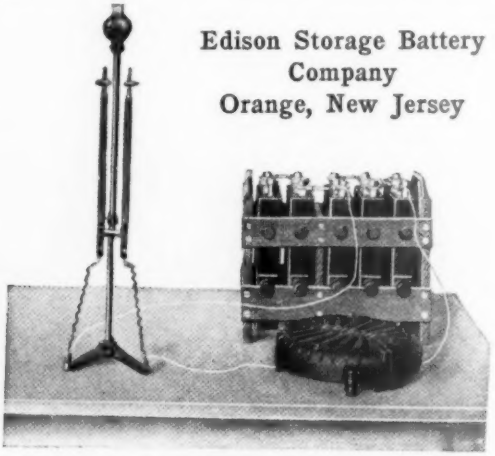
STEEL ALKALINE STORAGE BATTERIES

For every experiment in such new manuals as those of Fuller and Brownlee, Black and Davis, and for practically all of the demonstrations in direct current, the Edison Alkaline Cells can be used. The individual experiments which are commonly done with the alkaline cells cover nearly the entire list of electrical principles.

The Edison Battery will withstand practically all ordinary mechanical or electrical mistreatment. An occasional dead short circuit will not injure nor will the Edison Battery be permanently injured by charging in the reverse direction. It may be left standing idle indefinitely either charged or discharged.

Upon application you may have without charge, as many copies as you can use of Monograph 111 of the National Education Association Joint Committee Series, a text book describing Edison Steel Alkaline Storage Batteries. Ask for Bulletin No. 804.

Edison Storage Battery Company
Orange, New Jersey

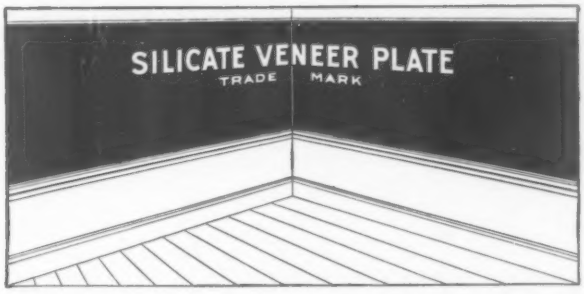


The electrolysis of water. Note that current may be regulated by number of cells used as well as by the rheostat.

N. Y. SILICATE BOOK SLATE COMPANY

20 VESEY STREET, NEW YORK, N. Y.

Factory: 625-633 Monroe Street, Hoboken, N. J.



SILICATE VENEER PLATE BLACKBOARDS

Silicate Veneer Plate Blackboards are composed of the best grades of wood pulp; the four veneers are firmly united under great pressure. The marking surface of these blackboards is Silicate Black Diamond Slating, which has been in constant use by the United States Government for the past thirty years and by most all of the principal Boards of Education for the last fifty years. Made in sizes up to 12 feet long.

SILICATE REVOLVING BLACKBOARDS AND STANDS

Silicate Revolving Blackboards are made of high-grade finished oak and are firmly put together with bolts. Easily assembled by any person, making a strong, portable blackboard that can be revolved either at the sides or the top and bottom. Made to fit blackboards from 2 x 3 feet to 4 x 6 feet.

CORK COMPOSITION BULLETIN BOARDS

Made in sizes from 18 x 24 inches to 4 x 6 feet. Finished on one side only. Enclosed in varnished oak frames.

SILICATE PRODUCTS

Book Slates
Panel Tablet Slates
Stone Slate Blackboard
Asbestos Blackboards
Wall Blackboards
Flexible Roll Blackboards
"Lapilinum" Slated Cloth
Liquid Black Diamond Slating
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This "Chalk Talk" merely consists of a few **"Don't's."**

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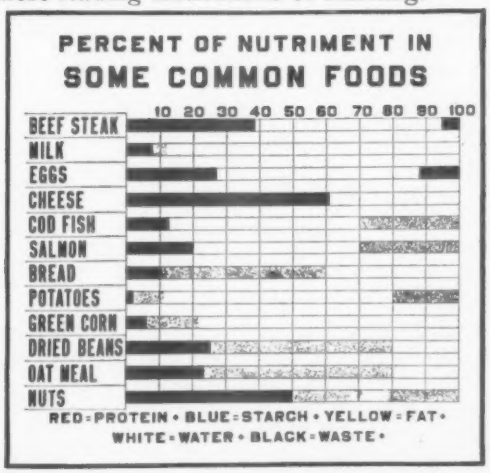

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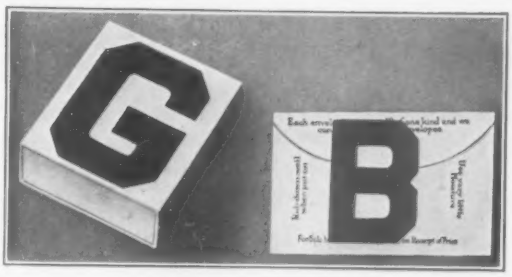

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Section V

CAFETERIA AND HOME ECONOMICS

Layout and Equipment of High School Cafeterias

BY WILLARD S. FORD, PH.D.

PROFESSOR OF EDUCATION, UNIVERSITY OF SOUTHERN CALIFORNIA

THE cafeteria is now recognized as an essential part of every high school building. Sixty-seven per cent of all of the high school buildings the plans of which were published in the *American School Board Journal* for the years 1924-25, contain cafeterias. Ninety per cent of all of these schools with a capacity of 700 or more pupils contained cafeterias.

The addition of the cafeteria to the high school plant has been a comparatively recent one. To this may be largely attributed the fact that many of the present cafeterias have been poorly planned, for they contain unnecessary space or are unsuited for the present needs. As illustration of this poor planning, one school cafeteria has 37.6 square feet per dining-room seat, another has 33.9 square feet per seat, and still another 28.3 square feet per seat.* The required space provision in the cafeteria dining-room as determined by the author in the study of 121 high school cafeterias, is 9 square feet. In one of these cases four times the required space was provided. In the study above referred to an attempt was made to discover the room and space requirements for the high school cafeteria and to standardize these elements.

* Willard S. Ford: "Administrative Problems of the High School Cafeteria." Bureau of Publications, Teachers College, Columbia University. 1926. Page 132.

Factors to be Considered in Cafeteria Planning

Many details must be given consideration in the planning of the cafeteria. Six of these factors will be discussed in this article, as follows:

1. The number of students for whom provision should be made
2. Types of rooms
3. Space requirements for the different rooms
4. Location of the cafeteria
5. Utilization of the cafeteria
6. Efficiency of arrangement

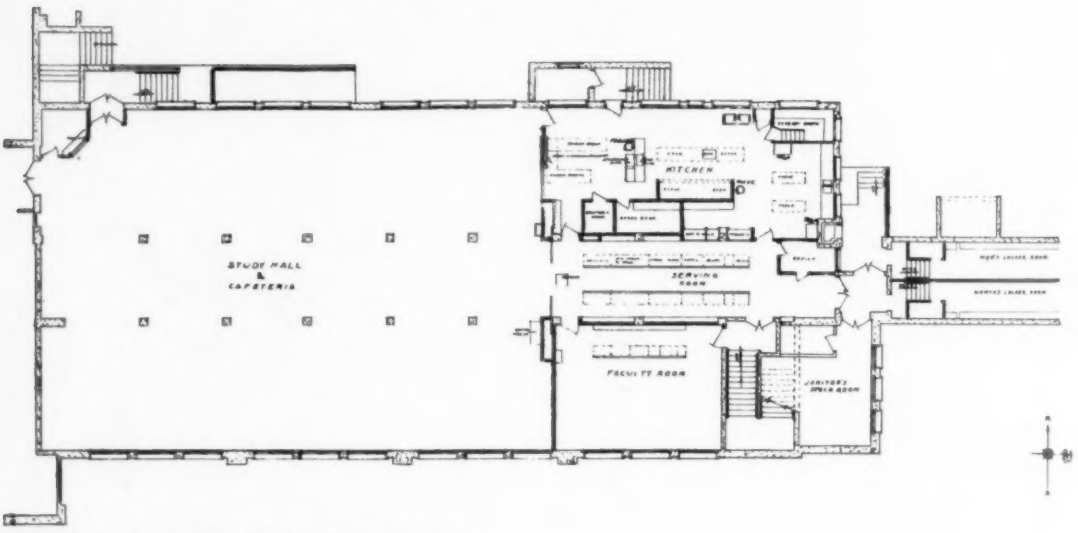
Number of Students.—The tendency is for an increasing number of students to patronize the cafeteria. In schools which have a continuous session, from 80 to 90 per cent of the students will eat in the cafeteria. It is the policy in many schools to require all of the students to remain on the campus. In this case practically the entire student body will eat in the cafeteria, either bringing their own lunch or purchasing part or all of their lunch from the school. To secure maximum utilization of the cafeteria, three lunch periods should be provided. Under these circumstances the dining-room should seat approximately 35 per cent of the total number to be served. In schools that dismiss for noon lunch there is a wide range in the number of students who will use the cafeteria. From 10 to 50 per cent may be expected

TABLE I

PER CENT OF EACH CLASS OF SCHOOLS WHICH PROVIDE THE INDICATED ROOMS FOR CAFETERIA SERVICE

	Enrollment				Date of Construction	
Rooms	400 to 800	800 to 1,400	1,400 to 2,000	2,000 and up	Since Jan. 1920	Before 1920
Dining-rooms—boys and girls	88.4	92.5	88.2	62.5	92.0	72.2
Boys only	7.7	7.5	11.8	31.2	6.8	25.0
Girls only	11.5	7.5	11.8	25.0	8.1	22.2
Faculty	26.9	35.0	61.7	87.5	44.6	50.0
Kitchen	92.3	100.0	100.0	100.0	100.0	97.2
Storage	80.0	87.5	97.1	93.7	89.2	91.6
Serving room	34.6	30.0	38.2	31.2	36.4	27.8
Locker room	7.7	25.0	17.7	37.5	28.4	11.1
Office or desk	7.7	12.5	41.1	25.0	24.3	25.0
Dish-washing room	7.7	15.0	26.4	18.8	16.2	16.7
Refrigeration room	3.8	5.0	11.8	6.2	6.8	2.8

NOTE.—The above data are based on 116 high school buildings.



John C. Austin and Frederick M. Ashley, Architects;
Willard S. Ford, and Osman R. Hull, Educational Consultants

PLAN OF CAFETERIA, CITY HIGH SCHOOL, MONROVIA, CALIF.

to eat at school under these circumstances, depending on the size of the school and the distance from the homes.

Types of Rooms.—Some schools provide only kitchen and dining-room. A few provide only a kitchen and serving counter. These provisions are entirely inadequate for a school of average daily attendance of 400 or more. Table I presents the proportion of schools of different sizes which provide various types of rooms for cafeteria service. The usual practice is for the boys and girls to eat in the same dining-room. A separate faculty dining-room is usually provided in schools of 1,000 or more enrollment. Thirty-six per cent of the schools built since 1920 provide a separate serving room and 26 per cent of the larger schools provide a separate dish-washing room. It is the general opinion of cafeteria managers that storage room, manager's office, and locker rooms for the help are essential.

An illustration of a complete provision is given in the Monrovia, Calif., High School, constructed in 1928. The dining-rooms for students and faculty, kitchen, vegetable room, storage room, hand-out booth, service room, manager's office, lavatories, and locker rooms for both men and women employees are provided. A separate dish-washing room is not provided in this case, although its location separates it satisfactorily from the remainder of the kitchen. The office is located convenient to the outside entrance, so that salesmen or others doing business with the manager may find the office without difficulty. The proper handling of funds and keeping the books makes an office essential. The locker rooms are removed from the kitchen and yet are easily accessible and are independent of the students' locker and lavatory rooms. The hand-out booth is frequently provided in Southern California, where it is possible, if not desirable, for students to lunch out-of-doors the year round.

The following list of rooms is recommended for the cafeteria layout:

Students' dining-room	Service room
Faculty dining-room	Dish-washing pantry
Kitchen	Office
Storage room	Locker rooms

Lavatories

Space Requirements.—The average amount of space provided by 100 high schools for the entire cafeteria layout is 15.68 square feet per dining-room seat. The average for the various types of room are given in Table II. The dining-room, exclusive of service space, in these 100 schools contains 11.53 square feet per dining-room seat, on the average; the kitchen contains 2.46 square feet per dining-room seat, on the average; and the auxiliary rooms provided contain an average of 1.69 square feet per seat. When a list of 10 schools which are modern and well planned is selected, the average number of square feet per seat in the dining-room is reduced to 8.8. It is evident that 9 square feet per dining-room seat is adequate. The average provision of 13 selected schools for the kitchen is 1.07 square feet per dining-room seat. To provide the necessary equipment in the kitchen, a minimum size of 300 square feet should be provided. In cafeterias seating 500 or more one square foot per seat is adequate. As a general rule, a kitchen which exceeds these standards is less efficient because of the increase in walking distances for the employees. The unnecessary space which has usually been provided in the dining-room and kitchen would provide liberally for the auxiliary rooms which have frequently been omitted. For cafeterias seating approximately 500, one thousand

square feet is adequate to provide for serving space, storage rooms, office, and locker rooms.

TABLE II

NUMBER OF SQUARE FEET OF FLOOR SPACE PROVIDED FOR EACH SEAT IN THE DINING-ROOM

Room	Number of Schools	Average Number Square Feet	Standard Deviation
Dining-room (exclusive of serving space)	100	11.53	4.26
Kitchen (including dish-washing space)	98	2.46	1.33
Auxiliary rooms (serving space, storerooms, office, locker rooms, etc.)	100	1.69	1.87
Average total space provided per seating		15.68	

SPACE PROVIDED IN CERTAIN SELECTED SCHOOLS

Room	Number of Schools	Average Square Feet
Dining-room	10	8.8
Kitchen	13	1.07

Location of the Cafeteria.—Many high school cafeterias have been located in the basement. In most cases basement rooms are poorly lighted, unfinished, damp, and generally uninviting. This location should be avoided. The first floor has several advantages as the location of the high school cafeteria. It permits the outside entrance for the delivery of supplies. If placed on an upper floor, an elevator for supplies is needed. The first floor has the disadvantage that odors pass up to the other floors of the school. This is difficult to prevent, even with a good system of ventilation. Table III shows that 32 per cent of the schools have cafeterias on the first floor, which is the most frequent location, next to the basement.

The location of the cafeteria on an upper floor, when possible, is desirable. It is easier to provide good ventilation and light, which are two important factors in making the lunch period attractive and pleasant. The general atmosphere of the room is reflected in the conduct of the pupils and undoubtedly influences the patronage of the students and the value of the lunch from a health standpoint.

TABLE III

FLOOR LOCATION OF HIGH SCHOOL CAFETERIAS IN 62 SCHOOLS

Location	Kitchen Number	Kitchen Per Cent	Dining-room Number	Dining-room Per Cent
Basement	25	40.3	25	40.3
First floor	20	32.2	20	32.2
Second floor	3	4.8	3	4.8
Third floor	8	12.8	8	12.8
Fourth floor	4	6.4	5	8.1
Fifth floor	1	1.6	0	0.0
Sixth floor	1	1.6	1	1.6
Basement and first floor	45	72.5	45	72.5
Above the basement	37	59.7	37	59.7
Above the first floor	17	27.5	17	27.5

That the cafeteria be centrally located is important to reduce the travel distances of pupils going to and from the cafeteria and to prevent congestion which is likely to occur when the lunch room is placed in an isolated part of the building. Pupils will be coming and going in large numbers, thus requiring that the lunch room be adjacent to a main corridor. When the dining-room is used as a study room before and after lunch hour, there is added reason for the convenient location.

There seems to be no tendency to place the domestic science laboratories nearer to the cafeteria than the other classrooms. The domestic science laboratories and the cafeteria are designed for two distinctly different purposes: the former are for instructional purposes, and the latter is primarily for lunch service. The relatively small use of the product of the cooking classes in the cafeteria also indicates that no special effort need be made to locate them closely together.

Uses of the Cafeteria.—The investment of $40,000 or $50,000 in a high school cafeteria makes it desirable that a maximum use be secured for this investment. It is not possible to use the dining-room for more than three or possibly four lunch periods, and unless this large room is planned so that it may be used for other purposes, the room will be idle a major part of the day. There is a growing tendency in the planning of cafeterias to use them for other school purposes when not in use as lunch rooms. Table IV shows the uses made of the cafeteria by 73 schools. Thirty-seven per cent use the room for social events, 25 per cent as a study hall, and 22 per cent as a classroom. The most satisfactory secondary use of the cafeteria is as a study hall. When used for this purpose it is desirable that the serving room and kitchen be separated by permanent partitions which are sound-proof. This plan eliminates the noise, and the odors of cooking, and very greatly improves the appearance of the dining-room and study hall.

TABLE IV

PER CENT OF SCHOOLS WHICH USE THE CAFETERIA FOR OTHER THAN LUNCH PURPOSES

	Social Events	Study Hall	Class Rooms	Domestic Science	No Other Use
Number of schools	27*	18	16	1	21
Per cent of total	37.0	24.6	21.9	1.4	28.8

Total number of schools—73.

Number of school cafeterias used for some regular school purpose, 31, or 42.5 per cent.

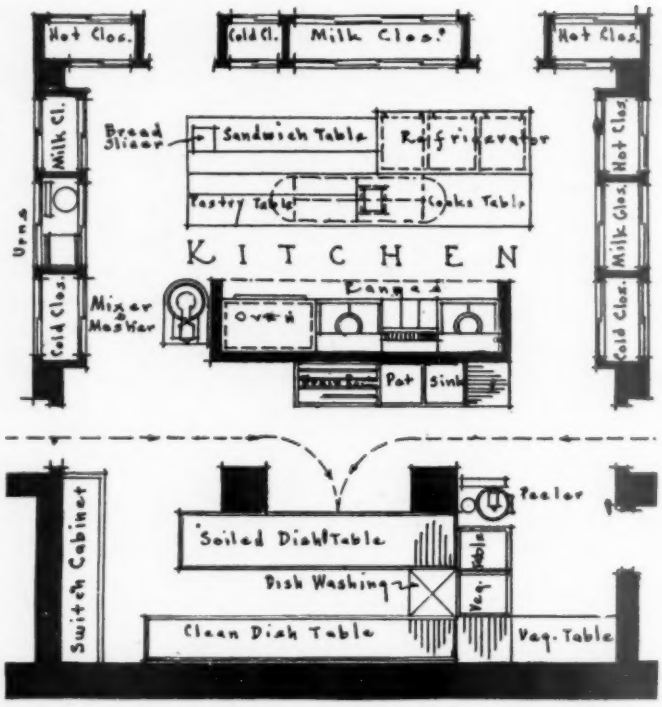
* It is probable that some schools failed to report the use for social purposes.

An excellent example of this use is given in the Orange, N. J., High School. An illustration given on page 120 shows this room with the doors folded back ready for service. When the folding doors are closed, the room can be used as a study hall. The arrangement of the Monrovia, Calif., High School cafeteria is similar. The Monrovia arrangement of the serving room permits a double line of service, which is necessary for the large school. Double doors are provided between the kitchen and the dining-room to eliminate noise. In the case of a large dining-room it may be desirable to divide it by partitions so that it may be used as two or

more separate study halls. The advantage of this use is that the number of students who are usually occupying the study hall during the day will be taking lunch in the cafeteria during the noon periods. The need for the study hall during the lunch period is thus eliminated. It may be seen that the cafeteria very nicely provides for both of these uses.

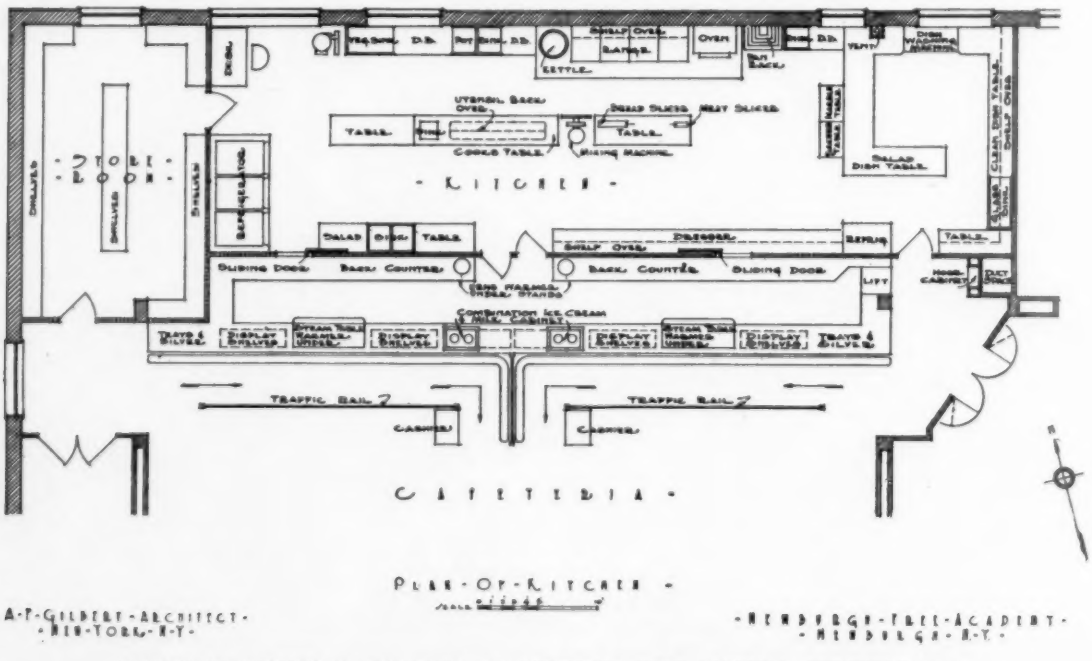
Efficiency.—The importance 'of good planning is closely related to the number of help required to operate the school cafeteria. The planning of the kitchen is one of the most important elements. The secret of good planning in the kitchen is to so arrange the equipment that each employee will be closely surrounded by all of his necessary supplies and equipment.

A good illustration of this type of planning is given in the cafeteria kitchen of the Warren Harding High School, Bridgeport, Conn. The pastry table, oven and mixer are a unit for the baker. The cook's table, range, refrigerator, and pot sink are convenient to the cook. The vegetable peeler, sink and vegetable table are convenient for vegetable preparation.



PLAN OF CAFETERIA KITCHEN IN WARREN HARDING HIGH SCHOOL, BRIDGEPORT, CONN.

A second excellent illustration of good kitchen on the unit basis is shown in the Monrovia High School kitchen. A counter to receive soiled dishes is placed at the end of the dining-room opposite the kitchen. When the students return their trays, an important saving in operation cost is effected. These dishes are trucked to the kitchen, received on the scrap table, cleaned, and trucked directly to the service counter without interfering with any other operation in the kitchen. Direct connection for the food trucks from both sides of the kitchen to the faculty service is provided. Both hot



LAYOUT OF KITCHEN IN CAFETERIA OF NEWBURGH FREE ACADEMY, NEWBURGH, N. Y.

and cold cabinets open from the kitchen into the service. It makes the replenishing of the service table convenient and easy. In this layout all cross-traffic is eliminated. The students enter through the service room and leave at the other end of the dining-room.

A good kitchen arrangement is shown in the Newburgh Free Academy of Newburgh, N. Y. Each unit is centralized, and direct connection from the kitchen to the service room is secured both through the double doors and through sliding doors opening to the back counter. The arrangement of the dish-washing pantry is excellent. The receiving and return of the dishes to the service counter is done without interfering with the delivery of the food to the counter.

Equipment Needs

A study of 121 high schools indicates that many schools are handicapped because of the lack of necessary equipment, and the others have an investment in expensive machines and other equipment which they do not use. The type of equipment required is largely dependent upon the food prepared and served. Table V shows the percentage of portions sold in 57 high schools. A total of 142,546 portions are included in the study. More than 40 per cent of the portions were desserts, half of which was ice cream. Approximately 21 per cent was sandwiches, bread and muffins, about 17 per cent soup, milk, and cocoa. Vegetables and salads were selected in 14 per cent of cases, while meat dishes were purchased in only 7 per cent of the cases. It is evident that good provision must be made for the serving of ice cream and other desserts. Special provision should be provided for sandwich making. This requires a bread slicer and a meat slicer. It is also evident that little provision need be made for meat preparation.

The examination of the length of counters provided and their use, indicates that a 30-foot counter is the most desirable length. This provides adequate room for the display of the variety of foods which the average high school cafeteria offers to its patrons. Few schools need more than two service counters, and in a school serving 1,500 students a period, three counters are adequate if the arrangement and service are well organized.

A study of these schools before referred to has resulted in the recommendation of certain service and kitchen equipment for schools of various sizes.

TABLE V

COMPARATIVE DEMAND FOR VARIOUS TYPES OF FOOD IN SCHOOL CAFETERIAS

	Per Cent
Desserts	
Ice cream, candy, cookies, cake, pie, soft drinks, puddings	40.27
Sandwiches, bread, and muffins	20.76
Soup, milk, and cocoa	17.58
Vegetables, salads, and fruits	13.69
Meat dish, meat substitute, frankfurter and roll	7.48

The equipment provision is based upon the number of students to be served. These lists of equipment are given in the column at the right:

SCHOOLS SERVING LESS THAN 200

Kitchen Equipment	Service Equipment
Cook's table	Counter
Range	Steam table
Pot sink	Ice cream packer
Soiled dish table	Pastry and dessert table
Clean table	Bread and sandwich table
Service refrigerator	Tray and silver rack
Vegetable sink	Cashier's stand
Vegetable and sandwich table	Dish heater
Bread cutter	Guide rail
Butter cutter	Water cooler
Pan rack	
Can opener	*Recommended Addition*
	Cash register
Recommended Additions	
Dish washer	
Small mixing machine	

SCHOOLS SERVING FROM 200 TO 500

Kitchen Equipment	Service Equipment
Cook's table	Counter
Range	Steam table
Pot sink	Ice cream packer
Soiled dish table	Pastry and dessert table
Clean dish table	Bread and sandwich table
Dish washer	Tray and silver rack
Service refrigerator	Cashier's stand
Vegetable table	Checker's stand
Sandwich table	Cash register
Vegetable sink	Dish heater
Bread slicer	Cocoa urn
Meat slicer	Water cooler
Butter cutter	Guide rail or partition
Vegetable peeler	Dish trucks
Mixing machine	Soiled dish trays
Pan rack	
Can opener	
Recommended Additions	
Dish washer	
Small mixing machine	

SCHOOLS SERVING 500 to 1,300

Kitchen Equipment	Service Equipment
Cook's table	Counter
Ranges	Steam table
Pot sink	Ice cream packer
Soiled dish table	Pastry and dessert table
Clean dish table	Bread and sandwich table
Dish washer	Tray and silver rack
Service refrigeration	Cashier's stand
Vegetable table	Checker's stand
Sandwich table	Cash register
Baker's table	Dish heater
Vegetable sink	Cocoa urn
Bread slicer	Milk and cream cooler
Meat slicer	Water cooler
Butter cutter	Guide rail or partition
Vegetable peeler	Dish trucks
Mixing machine	Soiled dish trays
Pan rack	
Can opener	*Recommended Addition*
Bake oven	Food truck
Recommended Addition	
Steam kettle	

SCHOOLS SERVING 1,300 OR MORE

Kitchen Equipment	Service Equipment
Cook's table	
Ranges	Counter
Pot sink	Steam table
Soiled dish table	Ice cream packer
Clean dish table	Pastry and dessert table
Dish washer	Bread and sandwich table
Service refrigerator	Cashier's stand
Vegetable table	Checker's stand
Sandwich table	Cash register
Baker's table	Dish heater
Vegetable sink	Cocoa urn
Bread cutter	Milk and cream cooler
Meat slicer	Water cooler
Butter cutter	Guide rail or partition
Vegetable peeler	Food trucks
Mixing machine	Dish trucks
Pan rack	Soiled dish trays
Can opener	
Bake oven	*Recommended Addition*
Steam kettle	Hot water urn
Recommended Addition	
Vegetable steamer	

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CAFETERIA IN THE ABRAHAM LINCOLN JUNIOR HIGH SCHOOL, ROCKFORD, ILL.
Designed and Equipped by Pick-Barth Kitchen Engineers

PRODUCTS

John Van Range Co. have for years manufactured equipment for the preparation and service of food, which is considered the standard of the educational field. Everything required for school cafeterias and kitchens is provided by this company: cafeteria counters, steam tables, chairs, tables, chinaware, glassware, silverware, linens and complete kitchen equipment. *VAN Cafeteria and Kitchen Equipment* is in use throughout the country in schools, hospitals, hotels and clubs, and has proved its superiority in years of service. Schools of every type and size can be equipped with a cafeteria—planned to meet any appropriation and any operating budget. *VAN Equipment* and *LORILLARD Refrigerators* are sold through the engineering staffs of ALBERT PICK & COMPANY, Chicago, and L. BARTH & COMPANY, INC., New York.

PLANNING

In planning your school, be sure that your architect provides plenty of space for the cafeteria in a light, airy location. This should be easy of access for delivery of food products, etc. If in doubt about this important question, send preliminary plans or blue prints to Albert Pick & Company, Chicago, or L. Barth & Company, Inc., New York, whose engineers will be able to make constructive suggestions. No obligation for this service.

CAFETERIA AT THE UNIVERSITY OF WISCONSIN, MADISON, WIS.
Designed and Equipped by Pick-Barth Engineers

The actual planning of the school cafeteria is a task that requires the services of a skilled kitchen engineer with whom your architect will consult. Every school has its own requirements based upon size, location, community, attendance, age of pupils, etc.—hence the cafeteria should in each instance be specifically designed to meet the school's individual needs. Engineers of this company are available for consultation—without fee or obligation, as explained below.

The first cost of equipment is important. So is the *operating cost.* It is therefore advisable to specify *VAN Equipment* which is low in first cost and lastingly economical. It is adaptable to any plan and any budget.

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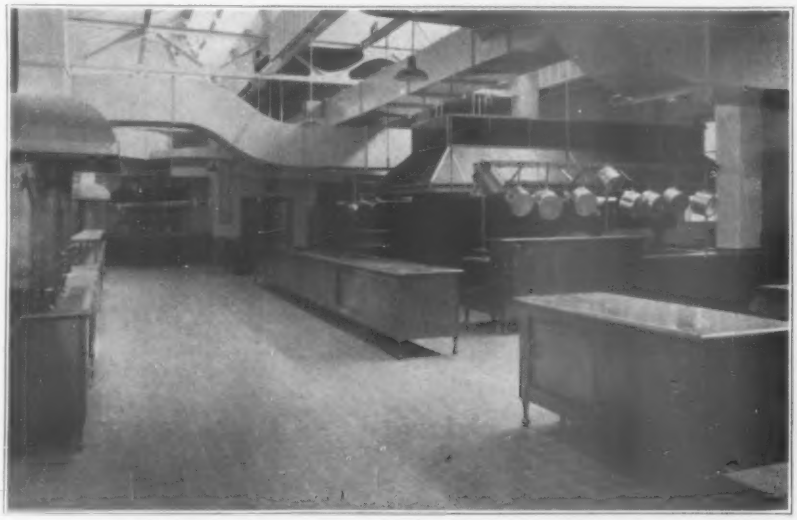


KITCHEN IN GIRARD COLLEGE, PHILADELPHIA, PA.
Designed and Equipped by Pick-Barth Kitchen Engineers

Section VI

LABORATORY AND SHOP

Shop Layouts for Junior and Senior High Schools and Vocational Schools

BY GEORGE E. HUTCHERSON

SUPERVISOR OF INDUSTRIAL ARTS EDUCATION, NEW YORK STATE EDUCATION DEPARTMENT

SHOP space and equipment should be considered at the time that the complete program of the school is being decided upon. The number of shops and the kind of shops to be equipped are wholly dependent upon the kind of school and program of which they will form a part. There are two major kinds of schools in which shop courses will be considered: junior and senior high schools, where industrial courses are offered for general education, exploratory, avocational and limited pre-vocational values; and vocational schools, to include trade schools, technical high schools and part-time schools, where the purpose of shop work is pre-vocational.

The local community may meet its needs for industrial training as follows:

Industrial arts
1. General shop
2. Special shops for exploratory, and pre-vocational values in local dominant industries

Vocational education
1. Day trade or technical classes
2. Day or evening apprentice training classes
3. Day part-time, industrial arts or trade extension classes

Since the objectives of the industrial work offered in junior and senior high schools and in vocational schools and courses are different, it has become common usage to refer to the one as industrial arts and to the other as trade or vocational work. Industrial arts courses are properly associated with the general educational and exploratory work carried on as a part of general education, and trade and vocational courses should be thought of in connection with vocational, technical and part-time schools. In part-time schools some industrial arts work is common, as it serves a need for general education and exploratory work necessary to such an institution.

Vocational education for trade and junior technical occupations demands a kind of school organization and method which differs widely from accepted standards of organization in the academic school. All of these things make it difficult to consider shop work on a vocational level as a part of the usual junior or senior high school program. Wherever the size of the community and the number of pupils will warrant, the vocational school should be set up as a separate organization, and courses and shops should be provided to satisfy the local demands for vocational training.

Shop work for the junior high school must be planned in accordance with the objectives of such an institution. Both industrial arts and vocational courses are valid. As has been pointed out previously, it is extremely difficult to conduct a good vocational program in conjunction with the usual junior or senior high school because of the special organization requirements of trade classes.

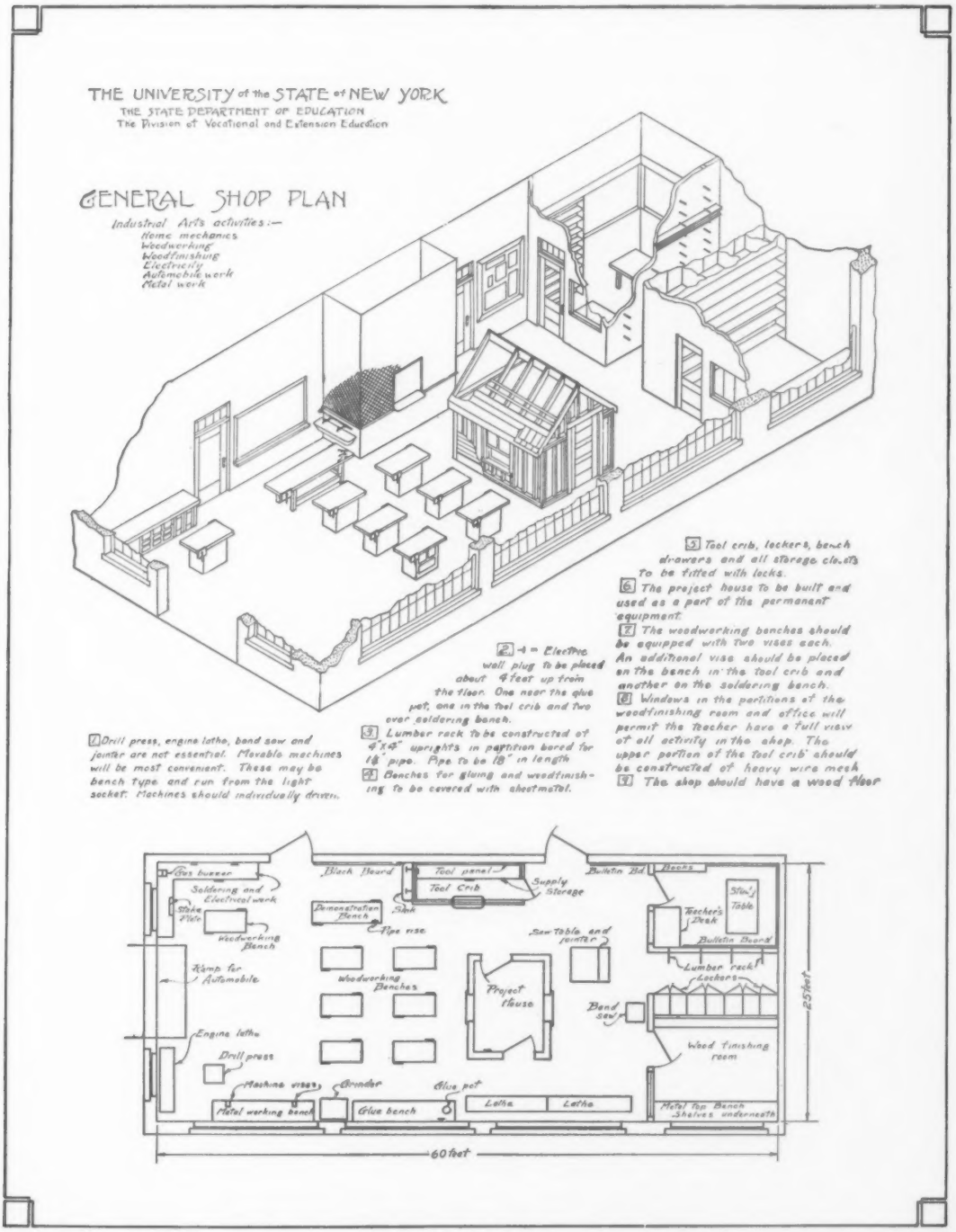
Industrial Arts Program for Junior High School

The industrial arts program for the junior high school should include instruction in common and accessible occupations, together with prominent local industries.

Common	Local
Building trades	Here might be listed those industries which are prominent and for which the school may offer some training.
Woodwork	
Woodfinishing	
Carpentry	
Electrical work	
Concrete work	
Mason work	
Automobile trades	
Metal trades	
Machine work	
Sheet metal work	
Drafting trades	

The general shop, suggestive arrangements for which are given in figures 1, 2 and 3, is meeting with popular favor to satisfy the requirements of diversified instruction in the early part of the junior high school period. To meet the demands

of more special training in the years that follow, unit shops may be provided to offer instruction in dominant local industries or in those fields of work initiated in the general shop. As some shop work is quite generally required in grades seven and eight, the diversified instruction possible in the general shop meets the needs of all boys with reference to general use of tools in home repair and maintenance work, guidance and avocational interests. Such instruction is also fundamental to a number of common industrial occupations. The small school or community unable to provide more than one teacher and space for one shop will find this arrangement well suited to its needs.


THE UNIVERSITY of the STATE of NEW YORK
THE STATE DEPARTMENT OF EDUCATION
The Division of Vocational and Extension Education
GENERAL SHOP PLAN
Industrial Arts activities:—
Home mechanics
Woodworking
Woodfinishing
Electricity
Automobile work
Metal work
[1] Drill press, engine lathe, band saw and jointer are not essential. Movable machines will be most convenient. These may be bench type and run from the light socket. Machines should individually driven.
[2] 4 = Electric wall plug to be placed about 4 feet up from the floor. One near the glue pot, one in the tool crib and two over soldering bench.
[3] Lumber rack to be constructed of 4"X4" uprights in partition bored for 1½" pipe. Pipe to be 18" in length
[4] Benches for gluing and woodfinishing to be covered with sheetmetal.
[5] Tool crib, lockers, bench drawers and all storage closets to be fitted with locks.
[6] The project house to be built and used as a part of the permanent equipment.
[7] The woodworking benches should be equipped with two vises each. An additional vise should be placed on the bench in the tool crib and another on the soldering bench.
[8] Windows in the partitions of the woodfinishing room and office will permit the teacher have a full view of all activity in the shop. The upper portion of the tool crib should be constructed of heavy wire mesh
[9] The shop should have a wood floor
Gas burner
Soldering and Electrical work
Stake Plate
Woodworking Bench
Ramp for Automobile
Engine lathe
Drill press
Machine vises
Grinder
Metal working bench
Glue bench
Glue pot
Lathe
Lathe
Black Board
Tool panel
Tool Crib
Supply Storage
Demonstration Bench
Sink
Pipe rise
Woodworking Benches
Project House
Saw Table and jointer
Bulletin Bd
Books
Stool Table
Teacher's Desk
Bulletin Board
Lumber rack
Lockers
Band saw
Wood finishing room
Metal Top Bench Shelves underneath
25 feet
60 feet

FIGS. 1 AND 2

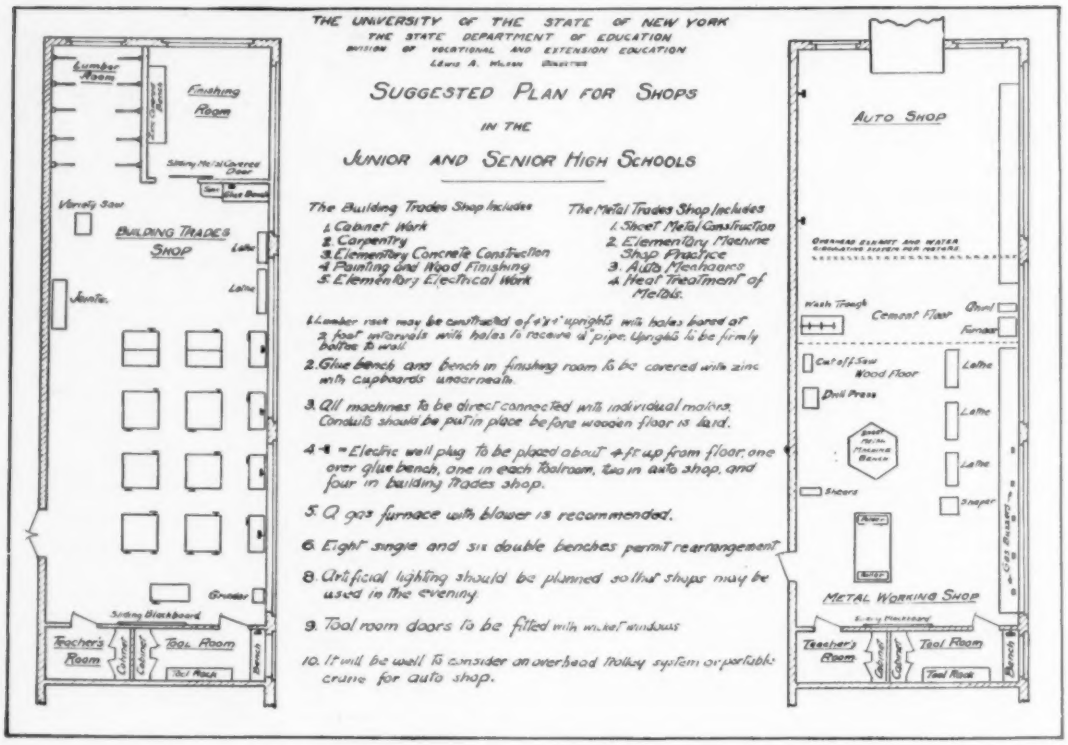

THE UNIVERSITY OF THE STATE OF NEW YORK
THE STATE DEPARTMENT OF EDUCATION
DIVISION OF VOCATIONAL AND EXTENSION EDUCATION
Lewis A. Wilson Director
SUGGESTED PLAN FOR SHOPS
IN THE
JUNIOR AND SENIOR HIGH SCHOOLS
The Building Trades Shop Includes
1. Cabinet Work
2. Carpentry
3. Elementary Concrete Construction
4. Painting and Wood Finishing
5. Elementary Electrical Work
The Metal Trades Shop Includes
1. Sheet Metal Construction
2. Elementary Machine Shop Practice
3. Auto Mechanics
4. Heat Treatment of Metals.
1. Lumber rack may be constructed of 4"x4" uprights with holes bored at 2 foot intervals with holes to receive 1" pipe. Uprights to be firmly bolted to wall
2. Glue bench and bench in finishing room to be covered with zinc with cupboards underneath.
3. All machines to be direct connected with individual motors. Conduits should be put in place before wooden floor is laid.
4. = Electric wall plug to be placed about 4 ft. up from floor, one over glue bench, one in each Toolroom, two in auto shop, and four in building trades shop.
5. A gas furnace with blower is recommended.
6. Eight single and six double benches permit rearrangement.
8. Artificial lighting should be planned so that shops may be used in the evening.
9. Tool room doors to be fitted with wicket windows
10. It will be well to consider an overhead trolley system or portable crane for auto shop.
Lumber Room
Finishing Room
Glue Bench
Variety Saw
BUILDING TRADES SHOP
Lathe
Lathe
Jointer
Grinder
Sliding Blackboard
Teacher's Room
Cabinet
Cabinet
Tool Room
Tool Rack
Bench
AUTO SHOP
Overhead Element and Water Circulating System for Heaters
Wash Trough
Cement Floor
Stool
Furnace
Cut off Saw
Wood Floor
Drill Press
Lathe
Lathe
Lathe
Sheers
Shaper
Blower
Motor
Gas Burners
METAL WORKING SHOP
Sliding Blackboard
Teacher's Room
Cabinet
Cabinet
Tool Room
Tool Rack
Bench

FIG. 3

Special Shops vs. General Shops

An optional plan is to provide several special shops and to route boys through these shops in the early part of the junior high school career. The time required to be spent in each shop varies from six to ten weeks. The selection of shops for this plan will be governed by (1) desirable shop instruction for all boys and (2) the particular industrial occupations of the local community. This plan has the advantage of well-qualified instruction in limited fields of work. It has the advantage of being beyond the reach of the small school or community.

A slightly more comprehensive plan for the school or community that can support two shops and two instructors is shown in plan No. 3. If a decision must be made where one or two shops are to be equipped, the arguments all favor the general shop layout.

The needs of the senior high school in the small community can be met with the general shop equally as well. The only difference would be in the nature of the equipment selected and the kind of instruction offered. The academic high school will find it desirable to offer industrial arts courses as electives in its program to meet avocational and pre-vocational needs of pupils.

The large community should provide day trade and technical instruction in accessible local occupations. These classes should be grouped in a separate school to permit freedom in organization. Where feasible to do this, the school should be open to pupils from the junior or senior high school on the basis of age, interest and aptitude of pupils. It is obviously impossible to present a standard set of shops to meet such a situation.

Plans which follow indicate a good arrangement for special shops which may be used either as industrial arts shops or as vocational shops. Large junior high schools which will find it possible to provide several special shops will do well to provide one or more general shops (see plan No. 1) for the introductory work of grade seven.

In general, the requirements as to space, equipment and arrangement of unit shops for high school, part-time school, trade and apprentice classes would be the same for any one field of work, such as electricity.

Features Important to All Shop Layouts

There are certain features which are important to all shop lawouts:

Floor space should be not less than 1,500 square feet. This will need to be increased in some shops where extensive and complete equipment is to be installed.

Light.—Good light is essential and should be provided on two sides if possible. Steel factory type sash is most satisfactory. Skylights are desirable. The window area should be at least one-

fourth of the floor area. Electric lighting should be provided to permit the use of shops for evening school work.

Floors should be strong enough to carry the weight of proposed equipments. The surface of floors should be wood wherever possible. Concrete may be used for automobile mechanics and mason trades.

Walls should be light in color. A dark color may be used to paint walls for a distance of five feet from floor.

Storage Space, Cabinets, etc.—Provision should be made in the shop for storage of supplies, tools, unfinished work, etc.

Power Supply.—Individual driven machines prove most satisfactory from the standpoint of safety and economy of floor space.

Blackboards, Bulletin Boards.—Each shop should have not less than 50 square feet of blackboard space. A multiple blackboard (one or more boards to slide up out of the way) provides an ideal arrangement and it is economical of space. All shops should have a good bulletin board at a point which is passed frequently by students.

A first aid cabinet should be provided for each shop.

Doorways and passages should be ample in size to permit passage of equipment, machines and articles made in shop. Automobile shops should have an entrance from outside for a car.

Plumbing.—Toilet and washroom facilities should be convenient to the shop. It is well to have a sink in each shop.

Exhaust and Safety Appliances.—All machines; guards should be approved by the proper state authorities. Machines which make an excessive amount of dust or poisonous gases should be provided with exhaust pipes and suction fans.

Sources of Assistance and Information

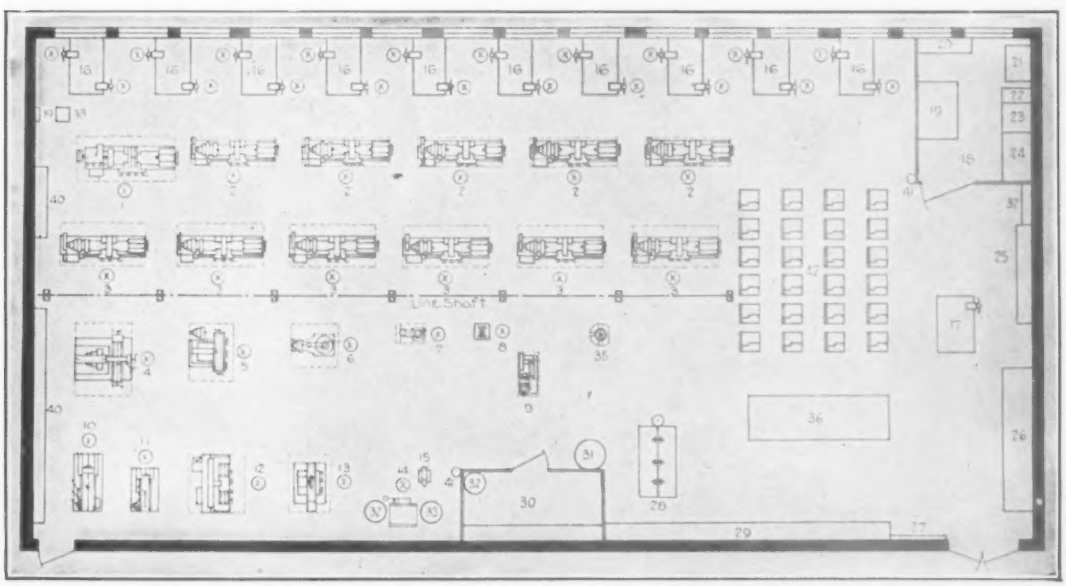
Within the space of this article it has been impossible to deal with a subject of this character adequately. When planning shops, the advice and assistance of specialists in the field should be consulted. State departments of education are always willing to give this service. In general it may be said that it is not safe to entrust this job wholly to the school architect. The following references are given, where more complete information may be had on shops and equipment:

Specification Annual, 1928. Bruce Publishing Co., Milwaukee, Wis.

Selection and Purchase of Equipment for Trade and Industrial Classes. Bulletin, No. 22, Trade and Industrial Series, No. 7. University of California, Berkeley.

Rooms and Equipment for Industrial Arts. Samuel A. Challman. Industrial Arts Brochure No. 3. Bruce Publishing Co.

The Shop Objectives and the Physical Equipment for Home Mechanics. Departments of Continuation Schools. William F. Rasche. Industrial Arts Brochure No. 5. Bruce Publishing Co.

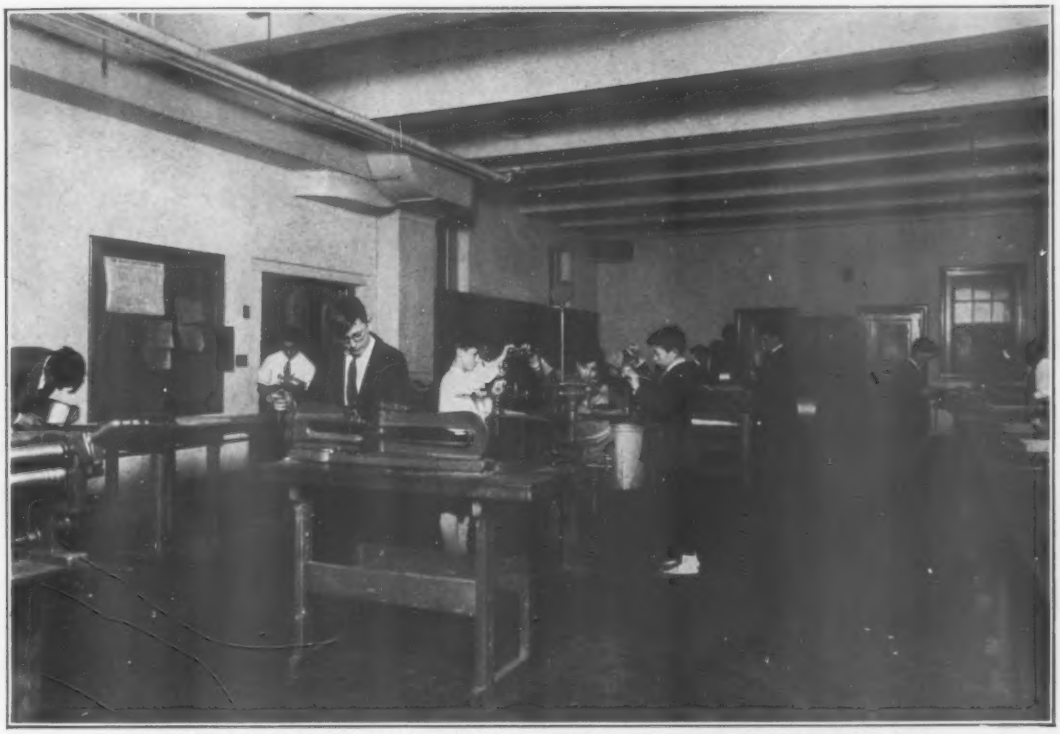


SUGGESTED PLAN FOR MACHINE SHOPS IN JUNIOR AND SENIOR HIGH SCHOOLS. NEW YORK STATE DEPARTMENT OF EDUCATION

1, 2, 3, lathes; 4, 5, milling machines; 6, 7, drill presses; 8, 12, grinders; 9, power saw; 10, 11, shapers; 13, surface grinder; 14, oven furnace; 15, anvil; 16, benches; 17, demonstration bench; 18, teacher's room; 19, desk; 20, bookcase; 21, drawing table; 22, filing cabinet; 23, locker; 24, cupboard; 25, sliding blackboard; 26, stock rack; 27, bulletin board; 28, sink, with drinking fountain; 29, students' cabinet; 30, tool crib; 31, 32, waste cans; 33, can for hardening oil; 34, can for hardening solution; 35, arbor press; 36, reference table for students; 37, panel switch box; 38, motor, 10 h.p.; 39, motor starting switch; 40, steel lockers; 41, fire extinguisher; 42, students' seats with writing arms. Individual lights for all machines and benches. Room 35 x 70 feet. Windows along one wall. X in circle indicates operator's position.

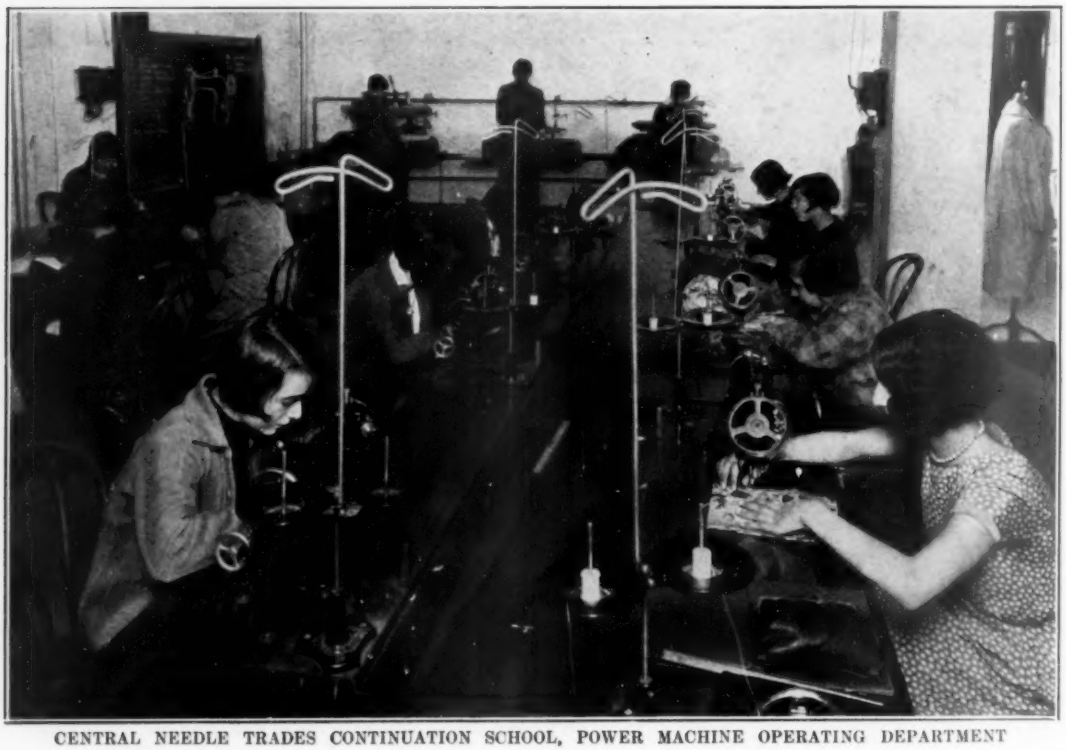
ONE END OF THE GENERAL SHOP, SHOWING THE TOOL CRIB. JUNIOR-SENIOR HIGH SCHOOL, BATAVIA, N. Y.

ELECTRICAL TESTING SHOP



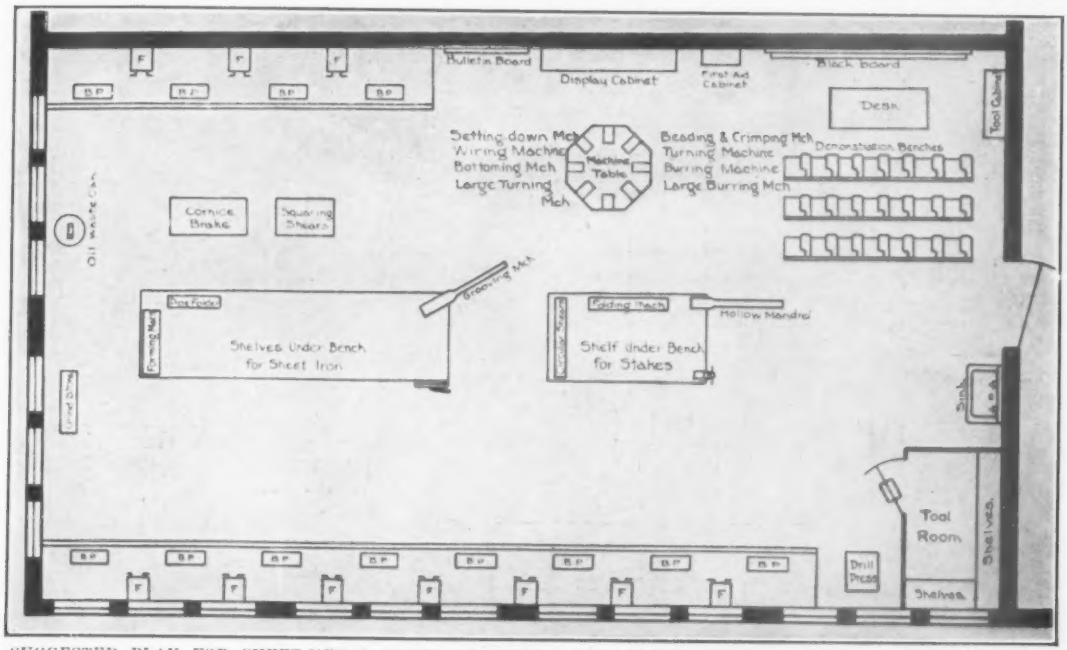
SHEET-METAL SHOP, BENJAMIN FRANKLIN JUNIOR HIGH SCHOOL, YONKERS, N. Y.

WOODWORKING SHOP, NATHANIEL HAWTHORNE JUNIOR HIGH SCHOOL, YONKERS, N. Y.



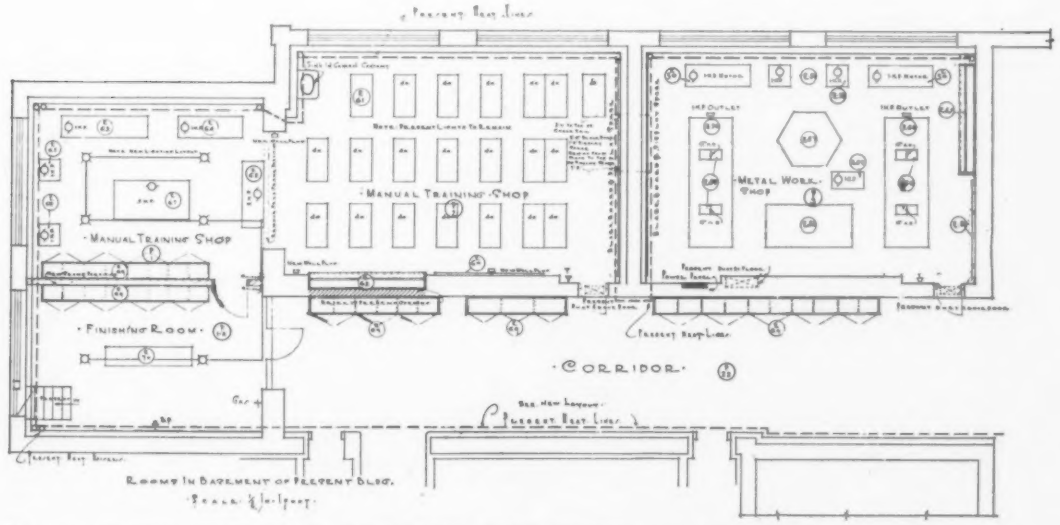
CENTRAL NEEDLE TRADES CONTINUATION SCHOOL, POWER MACHINE OPERATING DEPARTMENT

AUTOMOBILE MECHANICS



SUGGESTED PLAN FOR SHEET-METAL SHOPS IN JUNIOR AND SENIOR HIGH SCHOOLS. NEW YORK STATE DEPARTMENT OF EDUCATION

F, furnace; B. P., bench plate. Small bench to accommodate 8 boys, large bench 16 boys. Shelves under work benches for stock. Wall plugs for electric soldering coppers.



PLAN OF MANUAL TRAINING AND METAL-WORK SHOPS, ELEMENTARY SCHOOL NO. 62, BUFFALO, N. Y.

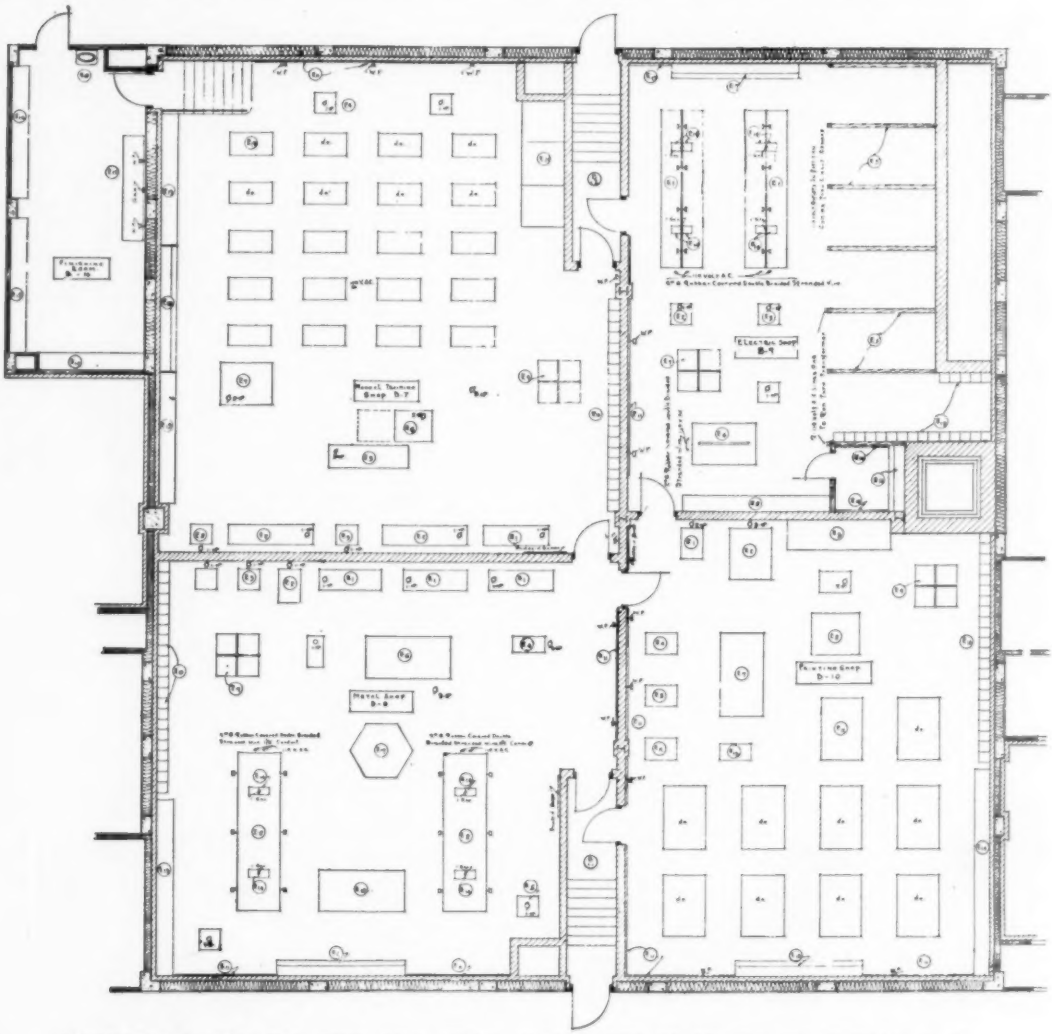
Equipment includes—

Manual Training Shops:

E60	1 tool panel
E61	21 Sheldon benches
E62, 69	6 cases
E63	1 lathe, 8-ft. bed.
E64	1 lathe, 6-ft. bed
E65	1 grinder
E66	1 drill
E67	1 variety saw
E68	1 jointer
E70	1 finishing table

Metal Shop:

E50	2 lathes, 6-ft. beds
E51	1 grinder
E52	1 drill
E53	1 sheet-metal storage
E54	2 work benches
E55	1 case
E56	1 tool panel
E57	1 hexo table
E58	8 bench gas furnaces
E59	1 power saw



EQUIPMENT LAYOUT FOR FOUR UNIT SHOPS, ELEMENTARY SCHOOL NO. 76, BUFFALO, N. Y.

Manual Training Shop, B-7:

E1	1 lathe, 6-ft. bed
E2	2 lathes, 8-ft. bed
E3	1 drill
E4	1 grinder
E5	1 jointer
E6	1 saw
E7	1 band-saw
E8	1 boring machine
E9	1 sink
E10	20 lockers
E11	1 blackboard
E12-16	6 storage cases
E17	1 finishing table
E18	1 sink
E19	20 Sheldon benches
E20	1 lumber storage

Sheet-Metal Shop, B-8:

E1	3 lathes
E2	1 shaper
E3	1 drill
E4	1 power saw
E5	1 grinder
E6	1 table
E7	1 hexo table
E8	2 double work-benches
E9	sinks
E10	22 lockers
E11	3 blackboards
E12, 13	2 storage cases
E14	8 bench gas furnaces
E15	1 table

Electric Shop, B-9:

E1	2 double work-benches
E2	1 drill
E3	1 grinder
E4	1 work table
E5	5 wiring panels
E7, 8	2 storage cases
E9	sinks
E10	2 tool panels
E11	1 blackboard
E12	1 storage case
E13	1 bulletin board
E14	8 bench gas furnaces
E15	20 lockers

Printing Shop, B-10:

E1	1 power stitcher
E2	1 power press
E3	1 work-bench
E4-6	3 hand presses
E7	1 imposing stone
E8	1 cutter
E9	sink
E10	22 lockers
E11	3 blackboards
E12	10 student tables
E13	1 proof press
E14, 15	2 storage cases

Layout and Equipment of the School Printshop

BY MERRITT W. HAYNES, M.A.

RECOGNITION of the educational values of printing and the consequent rapid introduction of this subject into the schools throughout the country presents to school administrators the problem of proper selection and arrangement of printing equipment. This problem should be worked out according to the same basic principles that should be observed in equipping any other school shop or laboratory. These principles may be summarized as follows:

1. The equipment should be selected primarily with reference to the objectives of the subject in the curriculum.
2. It should be adequate for the number of pupils to be accommodated, neither too meager nor excessive.
3. It should be of a quality in keeping with the furnishings of the rest of the school and the character of the community.
4. It should be arranged in the shop to secure maximum efficiency of instruction.

The Objectives of Printing as a Subject of Instruction

Pupil activities in the school printshop result in the production of such forms as tickets, posters, programs, instruction sheets and the school paper. Because these forms stimulate and vitalize the entire life of the school, and also since the production of them must be by group rather than individual effort, the school printshop achieves one of the major objectives of public education, namely, civic cooperation and socializing experience.

As secondary objectives to be served by pupils' activity in printing may be mentioned (1) the emphasis given to the *mechanics of English*—spelling, punctuation, paragraphing, etc.; (2) *consumer appreciation,* since every child who learns to read becomes a consumer of printing for the rest of his lifetime and should be taught to recognize and accept, as far as possible, printed matter of excellent quality; (3) *art appreciation,* since every printed page must be evaluated according to its artistic quality; and (4) *life-career exploration,* particularly in the junior high school.

These objectives may be attained by the use of the simple and basic items of printing equipment. Large scale or large volume of production is not necessary; therefore elaborate equipment is not desired. The outfit should provide for the rudimentary operations of printing—setting type in the stick, proving composition, making ready on the press, feeding the run and completing the job by folding, stitching, punching or padding. Since this work is done by novices rather than by experts, the equipment should be of minimum complexity.

Two or three platen presses (not larger than 12x18 inches) a proof press, a paper cutter, a small wire-stitcher and the necessary accessories together with the supply of type, will be sufficient. Such items as cylinder presses and type-setting machines should be installed in only the trade or vocational schools and the largest high schools.

The equipment of type should also be kept simple. A single type family in roman, bold and italic ranging in size from 6-point to 24- or 30-point, with a few job fonts in larger size for display, will be sufficient. In addition, a few sizes of card Gothic and a text face will furnish as much display as most school printshops should attempt. Good typography is characterized by simplicity, not by extravagance in display.

For school use the principal type face should be strong and rugged, with no hair lines or overhanging kerns, and with fairly open counters and fairly wide spacing. These factors make both for durability of type in handling and also for maximum legibility. For advanced pupils in the trade or vocational school, a classic face like Caslon should be provided, but this is not the kind of type face most suitable for beginners.

Accommodation of Pupils

There should be as many composing stands and composing sticks as there are pupils in the class. Every pupil receiving instruction during the term should also be provided with an individual galley for the storage of his composed type and other materials, so that these will not be molested by other pupils. Five classes of twenty pupils each per week would thus require one hundred galleys. (Galleys are inexpensive items.)

In the same manner, each pupil in the class should have an individual font of 10-point body type. Other sizes of type are less used, being required only for display work, and one or two fonts in each size will be sufficient for the whole class. Other items of equipment should be carefully selected so that the entire outfit will be well balanced with nothing unnecessary.

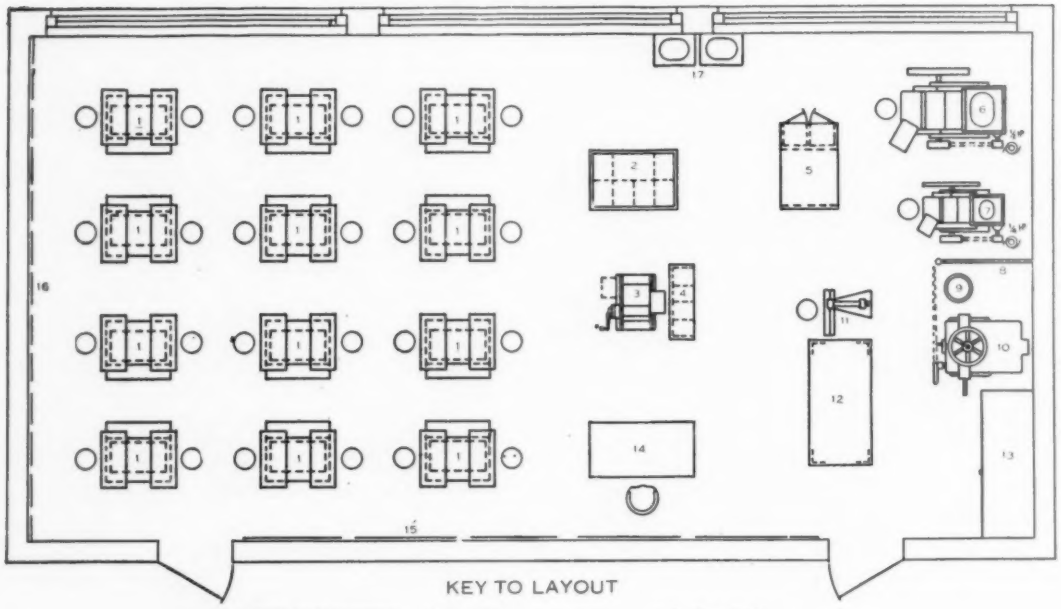
Quality and Safety

The school printshop should be just as attractive and dignified in appearance as the gymnasium, cafeteria, library, laboratories, or classrooms. Old-fashioned, unvarnished case racks and tables are therefore as much out of place in a modern

MODEL LAYOUT FOR A SCHOOL PRINTSHOP

TO ACCOMMODATE TWENTY-FOUR PUPILS

ROOM SIZE 24'-0" X 48'-0"



KEY TO LAYOUT

1 SCHOOL TYPE CABINETS
2 IMPOSING TABLE
3 PROOF PRESS
4 GALLEY CABINET
5 PRESSROOM CABINET
6 PLATEN PRESS 12 X 18
7 PLATEN PRESS 8 X 12
8 GUARD RAIL
9 WASTE PAPER RECEPTACLE
10 PAPER CUTTER 30"
11 WIRE STITCHER
12 BINDERY TABLE
13 STOCK CABINET
14 INSTRUCTOR'S DESK
15 BLACKBOARD
16 CORK EXHIBITION BOARD
17 LAVATORIES
POWER INTAKE
POSITION OF STUDENT

school printshop as they are in modern printing plants. Composing stands, imposing tables, drying racks and similar pieces should be of the cabinet style, nicely varnished, attractive in appearance, and compact and efficient in use.

It is of the utmost importance that proper safety precautions be observed in the installation of printing machinery. Platen guards, gear guards, flywheel guards, and brakes should be provided for all presses. Paper cutters should have safety latches. All belts and other moving parts should be securely inclosed. No avoidable chances should be given for pupils to incur injury from the use of the printing machinery.

Efficient Arrangement

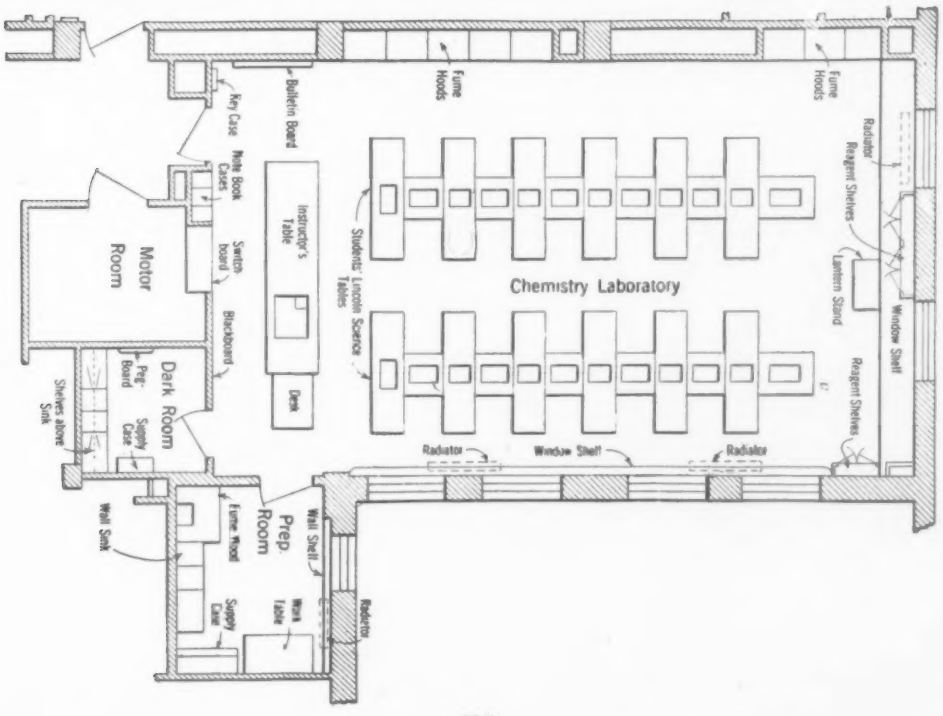
In laying out the printshop, due consideration should be given to the handling of the class, convenience of pupils in working at type case, press or other stations, utilization of window lighting, proper placing of artificial lighting and handling and storage of stock. Frequent washing of hands is necessary to produce neat printing, and should be provided for by adequate washbowls, preferably near the presses.

Before installing a school printing outfit, a careful layout should be made of the shop to determine the exact position of each piece of equipment. In fact, this layout should be made before selecting the items of the outfit for purchase, because the conditions of floor space will often determine just what style of furniture is most convenient. This is particularly true of type cabinets. Independent cabinets accessible on all four sides are preferred, but sometimes wall cabinets are necssary to suit the floor area and to give sufficient working space.

It is desirable wherever possible to plan a school printshop by collaborating with the architect before the construction of the building is begun. In this way the most satisfactory location of entrance doors, stockroom, lavatories, power outlets, electric lights and similar features can be secured without extra expense.

School officials will find it to their advantage to have their printshop layouts and complete specifications prepared by the engineering staff of a reputable printing-supply house. This service, which is usually rendered gratis to prospective customers, will prevent expensive mistakes in planning and will oftentimes suggest valuable ideas for securing the most advantageous items and arrangement of equipment.

The Chemistry Laboratory of Lincoln School, Teachers College, Columbia University, New York



The High School Science Laboratory

BY A. C. MONAHAN

FORMERLY SPECIALIST IN THE U. S. BUREAU OF EDUCATION

IN preparing to fit up and equip laboratories for high school sciences it is necessary first to know the approximate number of students who will enroll in these courses. For the United States as a whole, 53 out of every 100 high school pupils are taking science work. This includes only those in the four usual courses—"general science," biology, physics, and chemistry. Those in agriculture, domestic science, health and sanitation, and other special subjects, are not included in the above.

Of these 53 pupils, approximately 20 are in first-year science, 15 in second-year, 10 in third-year, and 8 in fourth-year science. In the average school, therefore, with 500 pupils, there will be 100 pupils in the Freshman general science course, 75 in Sophomore biology, 50 in Junior physics, and 40 in Senior chemistry.

In the small high school with, say, 100 or fewer pupils, if extreme economy must be practiced, the curriculum may be arranged so that only two science courses are given each year. In one year, general science would be given for Freshmen and Sophomores, and physics for the Juniors and Seniors. In the alternate year biology is given for Freshmen and Sophomores, and chemistry for Juniors and Seniors. A single laboratory may be made to do for all of this work. Two separate laboratories would be better, provided they are fitted with furniture which permits their use by other classes when not needed by the science groups.

In a slightly larger school, three science courses must be given each year—general science for Freshmen, biology for Sophomores, and physics and chemistry in alternate years for Juniors and Seniors. In the school of 500 pupils there will be three or four sections in Freshman general science, three in Sophomore biology, and two in both physics and chemistry. Four separate laboratories are therefore necessary. But if proper furniture is used, no classrooms or lecture rooms are needed.

Except in the very large high school, a separate lecture or demonstration room for science work is not essential, and it is not to be recommended unless there are enough classes and sections to keep it in constant use. A better plan is to have space at one end of the physics and chemistry laboratories for class demonstrations and recitations. (See Figure 1.) This means space for an instructor's lecture table and for tablet arm chairs for the class. A better plan is to install a type of laboratory table which may be used for seated pupils doing desk work or at recitation or watching a demonstration, and for standing pupils doing their regular laboratory experiments.

For the chemistry laboratory to be used for no other purpose than chemical experimental work, a table similar to Figure 2 is recommended. This

FIG. 1. CHEMICAL LABORATORY, RAMER SCHOOL, MONTGOMERY COUNTY, ALABAMA

is a photograph of a laboratory in the Kenosha, Wis., High School.

For physics laboratories, a 6-foot table, 3½ feet wide, is recommended. Each accommodates four students working at a time. These four-student tables are to be preferred to lorger tables, as each student can work from the front or side. Figure 3 illustrates this table. For biology and general science, tables 5 feet long and 2 feet wide are preferred. Each is for two pupils. While at work, standing or sitting, they all face the instructor's table at one end of the room. The laboratory is therefore suitable for recitation work as well as demonstration. Four-student tables are often used, similar to those used in physics. Twelve- and eighteen-foot tables are also often used, each taking care of four or six pupils, all facing in one direction. Any of these tables may be fitted with cupboards for apparatus. The illustration shows an installation of fifteen-foot tables, each for six students, in a New York State school. (Figure 4.)

Specifications of Laboratory Furniture

Of all furniture used in schools and colleges, that in the laboratory has the hardest usage. This is because the laboratory has greater extremes of humidity and temperature than other rooms, and is usually more or less filled with chemical fumes that are especially destructive to metals in the room. Water, acids, alkalies, alcohols, ethers, etc., are in constant use, and the table tops especially are constantly liable to damage from them. These same reagents are destructive to sinks and drainage unless properly guarded against. This all means that building laboratory furniture is a special business of its own, and is done by only a relatively few companies that have specialized in it. Much laboratory furniture put in schools, it is true, is made on the job by the building contractor or sometimes by a local planing mill, but it is seldom satisfactory. Even architects often recommend this type of furniture. This, however, is proof that they are not familiar with all the problems that laboratory furniture must meet. It is as poor a plan to have the laboratory furniture built by the contractor, or the millwork shop, as it would be to have the ordinary desks and seats for pupils made by them.

The furniture should be selected before the building is erected. Just as soon as the architect's general floor plans are completed is the proper time to select the furniture. Then the details for plumbing may be determined upon; and floor lines for water, gas, electricity and drainage, and for air pressure, hydrogen sulphide and other accessories when desired, may be properly provided for. Also, the artificial lighting may be placed to the greatest advantage. All these details are best worked out by laboratory engineers, their plans being incorporated by the architects in their final drawings. Such engineering service is available from the better manufac-

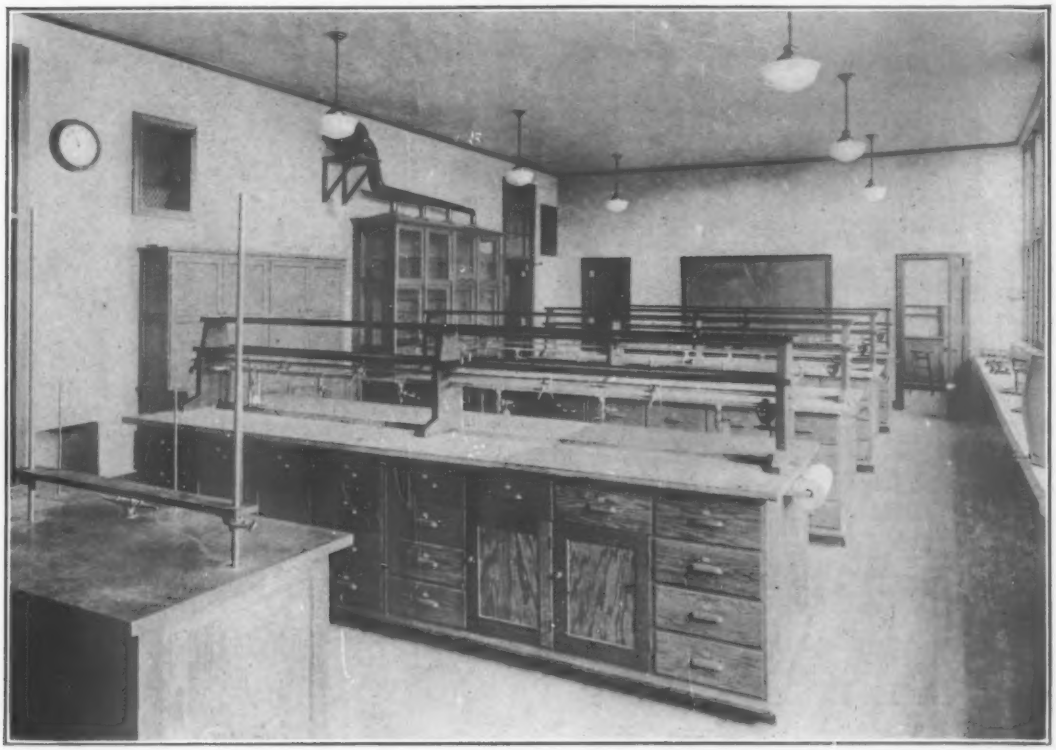


FIG. 2. CHEMICAL LABORATORY OF THE CENTRAL SENIOR HIGH SCHOOL, KENOSHA, WIS.

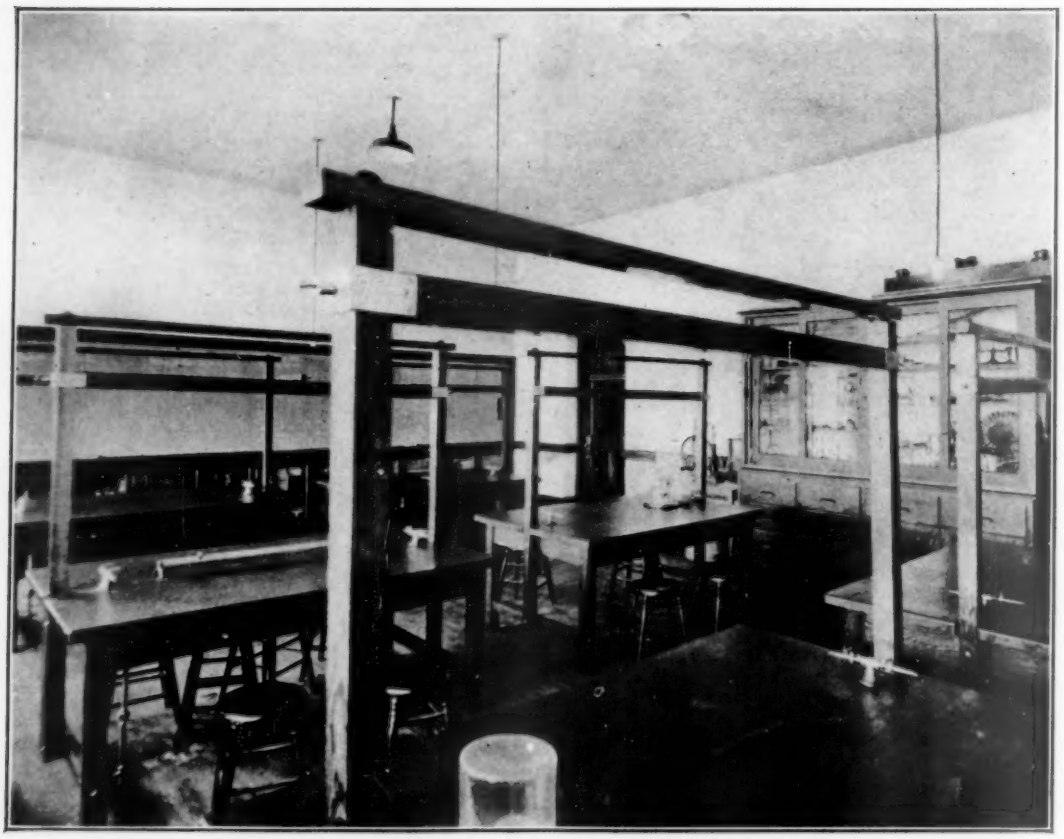


FIG. 3. PHYSICS LABORATORY, HIGH SCHOOL, BURLINGTON, N. J.

turers of laboratory furniture usually without expense to the school board or architect.

The laboratory desks for students and instructor, to be durable, should be cabinet-made of hardwood, oak to be preferred, except for tops. Metal cabinets seem to be subject to deterioration due to chemical fumes. The wood must be selected and dried as for any other good furniture. Plywood for panels, partitions, rears, and drawer bottoms should be used to lessen the dangers of splitting. The entire interiors should be varnished to prevent the absorption of water. The outside should be filled, stained, and varnished in harmony with the woodwork of the laboratory. From three to four coats of the best varnish are necessary to withstand the peculiar destructive agencies in the laboratory.

Laboratory table tops in chemistry are usually wood or soapstone. Occasionally, tile, glass, slate, composition board, or enamel ware is used, but experienced school and college men prefer the well-made wood tops or the soapstone. In physics, biology and general science, wood tops are used almost exclusively.

The wood tops which seem to be most satisfactory are made of 3- or 4-inch strips of hard Wisconsin birch put together with a glued tongued-and-grooved joint. Such tops are from 1½ to 2 inches in thickness and are made by the best manufacturers in one piece up to 36 feet in length. They are practically non-warping and give rigidity to be secured in no other way. These tops are planed and sanded to a smooth surface, treated on the underside with a moisture- and acid-resisting lead paint, and on the top with a standard acid-resisting treatment which leaves them with a black, velvety finish. By weekly washing with soap and water and by oiling two or three times a year, these tops retain their clean, finished appearance for many years.

Soapstone tops are made of sawed and honed stone slabs 1¼ inches thick and up to 6 feet in length. Care must be taken to select stone without calcide streaks, which would disintegrate rapidly from acids, also from strictures which may result in tops cracking with any settling there may be in the building. Joints between slabs are made watertight with litharge and pure glycerine cement, which must be renewed every few years. Center troughs for drainage are usually lead-lined, with burned joints, so that there will be no solder for acid action. This trough, if heavy lead is used, will prove as permanent as the furniture. Soapstone troughs are also used. Joints must be watched and cemented as soon as leakage takes place.

Great care must be taken in the cabinet work. Drawers will stick unless made with the peculiar conditions of the laboratory in mind. Cupboard doors will soon crack and break from hard usage by standing students unless exceedingly well made. Toe space along the front of the desks prevents the marking of the furniture from boots and shoes and at the same time permits the student to stand close to the desk.

Sinks are of chemical stoneware or soapstone. Enamel is sometimes used, but it is not very satisfactory. In the chemistry laboratory, in addition to the sinks on the desks, one wall sink should be provided. This should have a faucet two to three feet above the bottom of the sink to facilitate the washing of glass tubes, burettes, etc.

Hardware and plumbing fixtures in the laboratory require special care in the selection because of the severe effects on them of chemical fumes. As little metal as possible should be used in laboratory fixtures. Fittings should be of a high-grade red metal, triple nickel-plated. Chromium plating is now provided by at least one company. Brass is used, but does not resist the action of chemical fumes so well as red metal. Brass is satisfactory, however, for hinges for doors and for locks. All piping for water, electricity and air should be heavily galvanized iron. Gas pipe should be black iron. Joints must be made with particular care, using a deep thread and the best red lead or other standard joint compound. All drain piping should be of pure lead pipe or a heavy weight, with all joints burned instead of soldered. Duriron is also used.

The number of chemical fume hoods for the high-school laboratory depends to a large measure on the general ventilation system of the building and the room itself. If the building has a good system of supplying fresh air, and a gravity or plenum exhaust system for the removal of impure air, one 8-foot hood is sufficient. If the room has poor ventilation, additional work must be done under hoods, and two 6-foot hoods are desirable. These hoods are connected to a chimney, and draft is assisted by gas burners in the upper part of the hood, or, better, by electric exhaust fans.

One balance shelf or table, 8 feet long and 20 inches wide, is sufficient for the high school laboratory. Cabinets must be provided for the storage of apparatus and chemicals unless a supply room is provided.

Physics tables are usually equipped with gas and electricity. Outlets are on the side in the end rails, so that the tops are clear. Electrical outlets should be enclosed in an iron box, as required by the National Electric Code. No sinks are required on the tables, but the laboratory should have two wall sinks, at opposite ends of the room, if possible. The physics laboratory must be equipped with cabinets for apparatus and supplies, unless a convenient storage room is provided.

The biology laboratory should be equipped with an aquarium having plate-glass sides, with a museum case for the display of specimens, a germinating bed for planting specimens and watching the development of plant growth, a case for the storage of microscopes, and a cabinet for other apparatus. Chemicals should never be stored with microscopes or other apparatus in the same case in any laboratory.

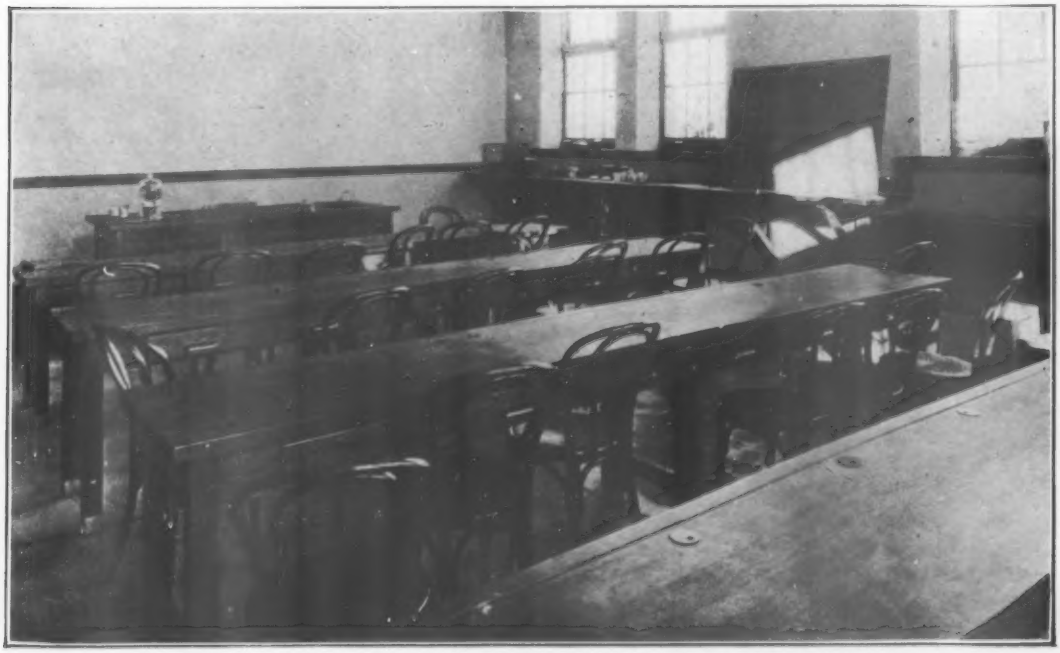


FIG. 4. BIOLOGY LABORATORY IN THE FAIRPORT, N. Y., HIGH SCHOOL

FIG. 5. CLASS IN MILK TESTING IN THE AGRICULTURAL WORKROOM OF THE HASTINGS, MICH., HIGH SCHOOL

Size of Laboratories

There is no special size that the chemical laboratory must be, except to be large enough to furnish space for students' desks so that each student will have working space, and for the additional equipment, including fume hoods, balance tables, and cabinets for apparatus. From 25 to 40 square feet per student is recommended by various authorities.

The size is determined largely by the number of pupils to be accommodated in the laboratory at one time. Common practice determines that not over 24 pupils may work in the laboratory at the same time under the supervision of a single instructor without neglect of the individual needs. Thirty pupils to the class is not an uncommon practice, although it makes a larger group than is desirable. In larger schools where an assistant instructor is available, laboratories for 40 to 60 pupils are satisfactory.

For a class of 24 pupils, the room to be used as a laboratory only, the standard classroom 22 or 24 feet wide by 30 or 32 feet in length may be used, although a room 34 to 38 feet in length is very desirable. This permits the use in the chemistry laboratory of three double student tables each 3 feet high, 12 feet in length, and 4 feet wide, placed crosswise with the room. For the physics laboratory, six-student tables each 6 feet long and 4 feet wide should be used. This gives the best arrangement for lighting and gives ample room on the inner wall for cabinets, balance shelves and fume hoods. Of course, such a laboratory may be used by two classes of 24 pupils each, or, if extra storage space is provided to the drawers and closets in the desk, a third class may use the room.

If a space for classroom work and demonstrations by the instructor is to be provided in the laboratory as recommended above, then the room will have to be longer. An instructor's demonstration table with the necessary space behind it for the instructor requires 5 to 6 feet. Three rows of tablet arm chairs for pupils will require an additional 9 or 10 feet.

Storage Space

Storage space for apparatus and supplies is of course essential. In a new building a storage room should be built adjacent to the laboratory. A 12 x 12-foot room is large enough for any of the four sciences in the small and medium high school. The chemical storeroom should be separate from that for the physical apparatus. Chemicals, glassware, porcelain, etc., may be placed in the same room, but physics apparatus, and balances and other apparatus used in chemistry should be put by themselves where chemical fumes will not reach them.

Certain pieces of apparatus should be put out in the laboratory where students can get them easily. These are best kept in storage cabinets with glass sliding doors. The cabinets must be well built, using all the precautions used in building laboratory tables. Chemical-resisting locks must be used so that the instructor may safeguard against stealing.

Cost of Laboratory Furniture and Supplies

This is a difficult figure to fix, as the cost of furniture made by different companies varies about in proportion to the quality as determined by the materials put into it, the type of construction, and the workmanship. The cost varies also with the accessories included. A chemistry table, for instance, piped for cold water and gas only, will cost less than one piped for water, gas, hydrogen sulphide, air pressure, electricity, etc. The well-built 12-foot table similar to that pic-

tured in Figure 2 will cost at the factory approximately $400. The 24-student chemical laboratory with the instructor's desk, fumehoods, and balance shelf, will cost from $1,550 to $1,980. The furniture for the physics laboratory is less, of course. A table with heavy built-up top of Wisconsin hard birch and with an acid-resisting finish, costs from $60 to $90. A 24-student laboratory with the instructor's table will cost, complete, $600 to $940. The 24-student laboratory for biology or general science with an aquarium and instructor's desk, costs approximately $800 to $1,320. Apparatus cases and storage cabinets for any of these laboratories, each case 4 feet in length, will cost from $100 to $150.

Apparatus and general supplies for the various courses mentioned, the particular pieces needed, the amounts, and the cost, cannot be discussed here for lack of space. For quite full information on this subject the reader is referred to a recent bulletin published by the U. S. Bureau of Education, entitled "Laboratory Layouts for High School Sciences." The lists in it are made up of the requirements of the various state departments of education. They are therefore minimum lists and are not as complete as desirable in the larger schools.

According to this publication, the cost of apparatus and supplies for classes of 24 pupils in each of the four usual sciences are as follows: chemistry, $700 to $1,000; physics, $1,500 to $2,240; biology, $600 to $900; general science, $300 to $350. Annual replacements cost as follows: chemistry, $240 to $360; physics, $200 to $360; biology, $50 to $200; general science, $50 to $100.

The Agricultural Science Laboratory

In the rural high school in which agriculture is an important part of the curriculum, the laboratories described above will answer for the agricultural sciences except for certain special work that needs a separate room. This is often called an "agriculture laboratory," but "agriculture workroom" is a better name.

In the science work of such a school, emphasis is placed on the scientific foundations of agriculture, and much of what might be called laboratory agriculture is covered. For instance, the principles of centrifugal force and experiments demonstrating these principles are covered in the physics course. The application of these principles in the Babcock milk test, and in the mechanical analysis of soils, is part of the agricultural course and is carried out in the agriculture workroom. In other words, in the regular science courses in the regular laboratories will be studied the chemical, physical and biological basis of agriculture. The class in agriculture will therefore, in the agricultural workroom, stick closely to the course itself and not have to delve into scientific principles that will divert their attention from the agricultural problem being studied.

The agricultural workroom is a room for "applied" agricultural work. Milk testing, seed grading, plant breeding, soil testing for mechanical composition, soluble salts content, acidity, water retention ability, etc., apple grading, poultry judging, egg testing, these are all subjects of laboratory study in the agricultural workroom.

The room itself should be the same size as the other laboratories. It should be equipped with student tables similar to the physics tables. It should have a seed-germinating bed, sinks with running water, cabinets and shelves for apparatus and charts and pamphlets. Figure 5 shows a class in milk testing in the agricultural workroom of the Hastings, Mich., High School.

The Science Department of the Haven Intermediate School, Evanston

BY LUCILE BERG HARRIS

SCIENCE INSTRUCTOR, EVANSTON, ILL.

THIS Department occupies a group of rooms that are ideal in every respect. The main laboratory is 22 feet x 70 feet, with an adjoining working laboratory and a dark-room. Added units on the roof consist of a standard greenhouse with plant beds, an animal house, and a dark storeroom for the propagation and starting of plants and bulbs. These rooms are directly connected with the laboratory below by a staircase and a dumb-waiter. The exposure of this department is to the south and southwest, which has the advantage of the sunlight in the afternoon when the children are a bit tired.

The walls of the main laboratory are lined with recessed cases, 7 feet in height, which contain 240 metal trays, each 3x7x11 inches, one for each pupil. These are arranged in class groups and kept under lock and key by the teacher. All additional space around the walls is filled with exhibition cases, arranged in setbacks with tackboard at the wall for the better presentation of specimens, which consist of sea life, rocks and minerals, dried and pressed plants, seeds, fruits, fossils, relics of dead races, birds' nests, and insects.

One of the most delightful features of the Department is the conservatory with its southern bay, containing a long propagating bed. It is really a workshop where the pupils are taught, a few at a time, to make cuttings from plants that will grow from slips. A pair of beautiful plumaged birds is kept here. Each week two pupils are appointed to care for the birds.

All plants that are started downstairs are eventually taken up to the greenhouse on the roof, to

IN THE SCIENCE DEPARTMENT, HAVEN INTERMEDIATE SCHOOL, EVANSTON, ILL.

finish getting their growth, before the pupils take them home. Seeds have been planted to start pansy beds on the school grounds and petunias for the school window-boxes. Both of these plant-rooms give the children living in apartments a place in which to dig and to raise flowers. Teachers from all over the building send bulbs to be started in the darkened plant-room.

The animal house collection, newly started this past fall, consists of a pair of squirrel monkeys and a tailless South American monkey, creatures of totally different temperaments; a ground hog that is very gentle; white rats for feeding-experiments; an ordinary gray rabbit (somewhat stupid in comparison with the one that is kept in the classroom); a tank of alligators, which at first caused numerous shivers but are now very much mauled by both the girls and the boys; a box of painted terrapins; some ringnecked doves that are kept for nesting; and a small songless canary. Each animal has a special diet and must have its cage cared for in a certain way. It is a privilege for a child to be allowed to care for an animal over a set period of time. The teacher never asks a child to do a task in the animal house which she has not let the children see her do herself; accordingly they feel no aversion to the tasks.

All of the animals are not kept in the animal house. A snake, some fish and turtles, and a rabbit are always downstairs. The snake, a five-foot King snake, is very gentle and enjoys being handled. At first the majority of the pupils shuddered when they saw her coiled on the teacher's arm, but one by one they have conquered their fear and the problem now is to keep them from coming too near the cage and from handling her too much.

The open-air classroom adjoins the animal house and greenhouse on the roof; it has a well-drained concrete floor and a parapet wall 3½ feet high around it. During the winter, the classes studied snowflakes and cloud forms there; in the spring term, they started the study of clouds and rain, and the approach of storms and lightning. The study of snowflakes was more for the joy of seeing the crystal designs than for any other purpose, but the pupils were taught the difference between blizzard flakes and low- and high-altitude flakes.

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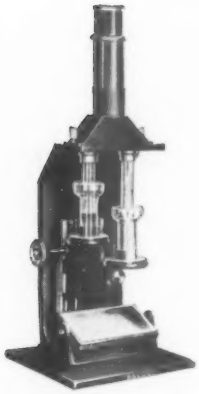

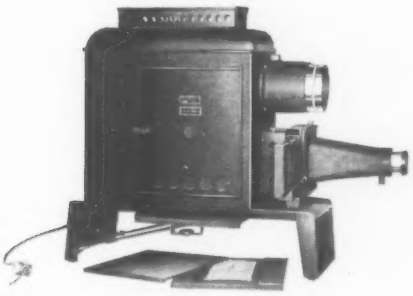

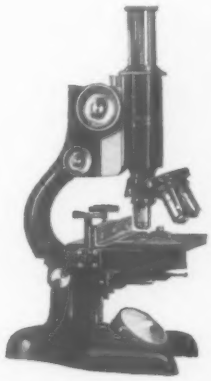

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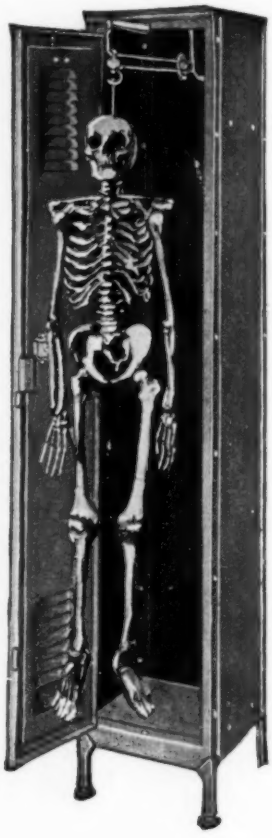

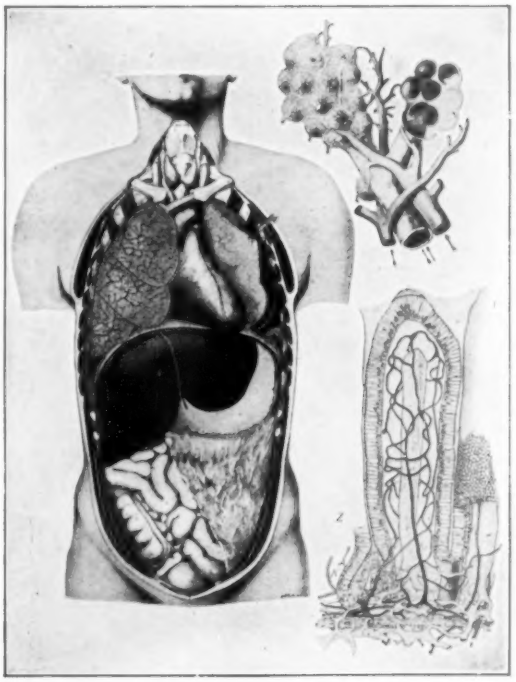

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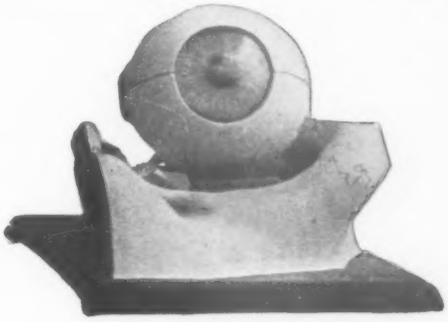

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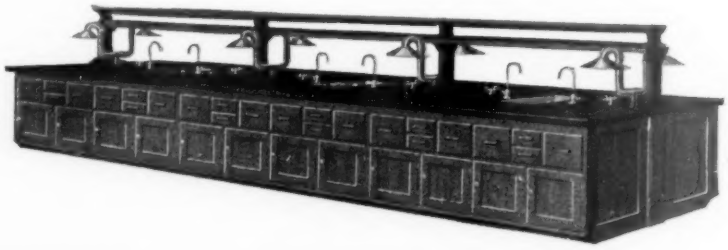

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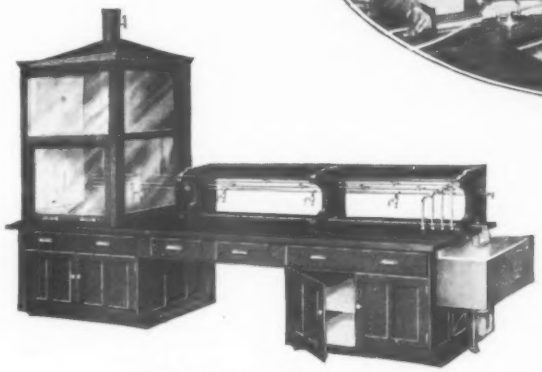

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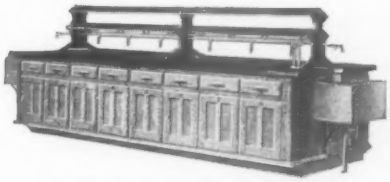

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Main Office: 153 West 23rd Street, NEW YORK

Quarries and Mills at Schuyler, Va.

BRANCHES

Boston, Newark, N. J., Philadelphia, Richmond, Va., Pittsburgh, Cleveland, Chicago

PRODUCTS (see also page 131)

Alberene Stone, a natural quarried stone, fabricated for the following laboratory purposes:

- Table Tops and Backs
- Reagent Shelving
- Fume Hoods
- Sinks and Drainboards
- Baths and Tanks
- Acid and Chemical Storage
- Acid-proof Flooring
- Pegboards

PHYSICAL AND CHEMICAL PROPERTIES

Alberene is a natural quarried stone, blue-gray in color, dense and non-stratified, chemically inert, acid-and-alkali-proof, impervious and non-staining, flame-resistant and fire-proof, non-absorbent and easily cleanable. It is easily machined—tongued, grooved, bored, drilled, slotted or turned—without splitting or spalling.

CONSTRUCTION EMPLOYED

Alberene Stone laboratory fixtures are built by methods possible with no other stone and which make them practically one-piece structures of solid stone. Table top slabs are united by a practically invisible joint employing a strip of non-corroding metal cemented in grooves, with abutting edges of the slab ground and sealed with acid-proof cement. Fume hoods, sinks and tanks are assembled with tongue-and-groove joints held by hidden bolts and nuts and cemented. Such joints are permanently gas-and-liquid-tight.

SERVICE IN DESIGN AND INSTALLATION

Every laboratory of major importance equipped in the past 20 years has used Alberene Stone wholly or in large part. Out of this large experience this Company offers an advisory service freely available to school and university authorities and architects.

STERLING CHEMISTRY LABORATORY YALE UNIVERSITY, NEW HAVEN, CONN.

UNIVERSITY OF WEST VIRGINIA, MORGANTOWN, W. VA.

BAKER CHEMISTRY LABORATORY CORNELL UNIVERSITY. ITHACA, N. Y.

THREE NOTABLE EDUCATIONAL LABORATORIES EQUIPPED THROUGHOUT WITH ALBERENE STONE

THE AMERICAN SCHOOL AND UNIVERSITY

CORNING GLASS WORKS

Largest Makers of Technical Glassware in the World

NEW YORK OFFICE: 501 FIFTH AVENUE

PYREX LABORATORY GLASSWARE

No wonder the confidence and appreciation of chemists and school chemistry departments throughout the world has been won by *PYREX Laboratory Glassware.

PYREX Glassware is unyielding to heat—indifferent to abrupt changes from hot to cold or from cold to hot—immune to the attack of the usual reagents—and ruggedly able to withstand constant and hurried handling. These unusual advantages mean a definite saving both in time and in money by avoiding costly breakage of equipment and spoilage of tests.

YOUR LABORATORY ALLY

PYREX is the one make of glassware upon which school chemistry departments can depend.

A remarkably low coefficient of expansion enables it to resist high temperatures and sudden cooling. It has great chemical stability. Its walls are heavier than those of any other make of laboratory glassware. Each piece is thoroughly tempered.

PYREX Laboratory ware is made to outserve and outwear all other kinds of laboratory ware.

HAVE YOUR SPECIAL APPARATUS MADE OF PYREX GLASSWARE

The breakage of your items of special equipment is doubly costly, both in time and in money. It will pay you to have them made of PYREX Glassware.

A PIECE OF PYREX GLASSWARE FOR EVERY LABORATORY NEED

Equip your laboratory throughout with PYREX Glassware. There is a piece and size for every need.

There are forty different types of flasks—those for everyday use and those for highly specialized laboratory processes. There are twenty different types of tubes. And there are beakers, reagent bottles, crystallizing and evaporating dishes, graduated and ungraduated cylinders, desiccators, stop cocks, funnels, seals and ground joints of every possible description, together with a complete line of special apparatus for distillation and other purposes. Further items of special equipment will be made in accordance with your specifications.

Write For Catalog.

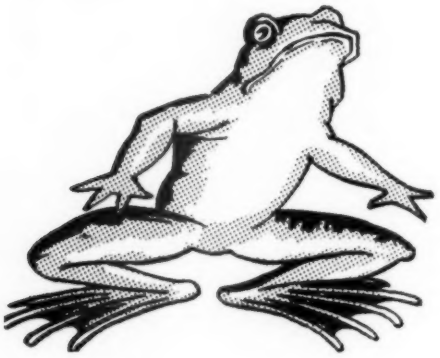
* Trade-mark Reg. U. S. Pat. Off.

F. J. BURNS & CO.

Dealers

Live Frogs, Turtles, Preserved Crawfish, Etc.,
for Biological Studies

1108 W. Randolph St., CHICAGO, ILL.



LIVE FROGS
LIVE TURTLES
PRESERVED CRAWFISH
LIVE RABBITS
LIVE PIGEONS
PRESERVED PERCH
SUPPLIED TO SCHOOLS
FOR BIOLOGICAL STUDIES

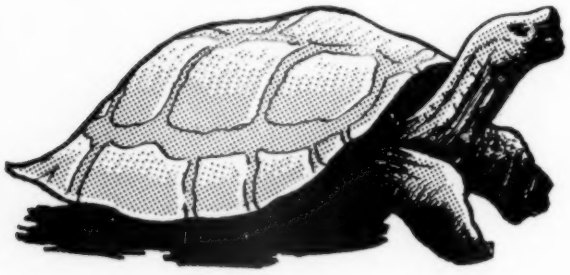
For over twenty years we have been supplying schools with subjects for their biological studies.

A large supply is kept on hand at all times.

As the prices vary from time to time, they will be furnished on request.

Shipments are made anywhere in the United States and Canada in practically any quantity required.

Further information will be gladly furnished.



THE GARLOCK PACKING COMPANY

Manufacturers of

GARLOCK MECHANICAL PACKINGS

General Offices and Factories

PALMYRA, NEW YORK

Canadian Office and Factory

MONTREAL, QUE.

Sales Offices and Warehouses in all Principal Industrial Centers

PACKINGS

There is a GARLOCK Quality Controlled Packing for every conceivable engine room and general equipment condition. They include air, alkali, ammonia, brine, gas, oil; high, medium and low pressure steam; hot and cold water service.

The Garlock Packing Company maintains a corps of Garlock Service Men in all parts of the country, who are Packing Experts. If you desire consultation on any packing problem, write the nearest branch office and a Service Man will call.

You will find listed below a few of the general service packings. Information on all other types will be furnished upon application. Send for General Catalog.

ROD AND VALVE STEM PACKINGS

GARLOCK-150

HIGH PRESSURE SPIRAL PACKING

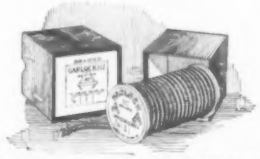
GARLOCK-150—High Pressure Spiral Packing is made of selected long fibre asbestos cloth with a non-vulcanizing rubber cushion, and lubricated throughout with Celebrated Garlock Compound. This packing is for use on piston rods working against high pressure and superheated steam, expansion joints, etc.

GARLOCK-777—Spiral Steam Packing is made of high grade rubber and duck and thoroughly lubricated. Particularly recommended for service on medium pressure steam, hot water and ammonia.

GARLOCK AMMONIA DUO is an extremely high grade ammonia packing.

GARLOCK-262—Special Hydraulic Coil Packing for service in connection with all water conditions.

GARLOCK-26—Gold Brand Flax Coil Packing is the best grade of long fibre flax and guaranteed pure.



GARLOCK-117 VALVE STEM PACKING

GARLOCK-117—Beaver Valve Stem Packing is made of long fibre asbestos thoroughly lubricated and is furnished either braided or twisted.

SHEET PACKINGS

GARLOCK-900—Compressed Fibre Sheet Packing for service in connection with high pressure and superheated steam as well as oil, ammonia, acids, etc.

GARLOCK-22—Red Sheet Packing, a general service rubber sheet packing.

GARLOCK-24—Wire Inserted Red Sheet Packing reenforced with wire gauze.

GARLOCK-19—Duck or Cloth Inserted Sheet Packing. This sheet is made of high quality duck and rubber and the plies held together with the best grade of friction.

GASKETS

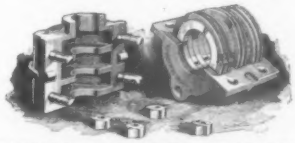
GARLOCK-604

HIGH PRESSURE FOLDED ASBESTOS GASKETS

GARLOCK-604—High Pressure Folded Asbestos Gasket for use as manhole or handhole gaskets on high pressure boilers.

GARLOCK-950—Compressed Asbestos Fibre Gasket particularly adaptable for working against high pressure and super-heated steam.

METAL PACKINGS



GARLOCK-805 METAL PACKING

GARLOCK-805—Floating Ring Type of Metallic Packing with split case adaptable for use on piston rods and valve stem working against steam, oil and gas. Information on shredded metal rings and other types of metallic packing furnished on application.

VALVES

GARLOCK-108—Hard Black Valve for hot water at high pressures and temperatures; also can be used for pumping gas, gasoline, oils, etc.

GARLOCK-175—Medium Soft Rubber Valve to be used in connection with pumping cold water at high and medium pressures.

VALVE DISCS

GARLOCK SPECIAL VALVE DISCS with round or oval hole and any diameter that is desired.

KIMBLE GLASS COMPANY

CHICAGO, ILL. VINELAND, N. J. NEW YORK, N. Y.

PRODUCTS

Glassware for laboratory and industrial use.
Kimble Glassware is Stocked by Responsible Laboratory Supply Dealers.

TRADE MARKS

Kimble Graduated Glassware

Kimble Resistant Glass Beakers and Flasks

Kimble Lampblown Glassware

CATALOGS

(1) **Kimble Resistant Glass;** Beakers, Flasks, Hydrometer Jars, Chemical Funnels, Petri Dishes, etc.

(2) **Kimble Graduated Glassware;** Burettes, Graduated Cylinders, Mixing Cylinders, Volumetric Flasks, Separatory Funnels, Glassware for Gas Analysis, Nitrometers, Pipettes, Centrifuge Tubes, Glassware for color testing and miscellaneous graduated items.

(3) **Kimble Lampblown Glassware;** Absorption Bulbs, Potash Bulbs, Condensers, Extraction Apparatus, Filter Pumps, Stopcocks, Syphons, Calcium Chloride Tubes, Distillation Tubes, Funnel Tubes, Test Tubes, Tubing and Rod.

(4) **Kimble Machine made Vials;** Manufactured of machine made tubing, have the following distinctive features:

a Minimum variation of diameter.
b All bottoms finished flat and even, no thin ones.
c Uniformity of height.
d Accuracy of corkage.
e Packed by special process in specially designed boxes, minimizing the possibility of breakage in shipment.

MANUFACTURING FACILITIES

Tubing and Rod—We are the exclusive manufacturers in the United States of machine made Tube and Rod for chemical purposes. Tube sizes: outside diameter 4 to 51 mm. All standard wall weights. Rod all standard sizes.

Glass Blowing—Complete facilities for producing standard and special shapes in lime and resistant glass.

Lampworking—The Kimble Lamprooms have been operated continuously for twenty years. Beginning with a small line of the simpler pharmaceutical items, this department of our business has reached that stage of development where we are now producing a complete line of standard and up-to-date apparatus which includes all items necessary for organized laboratory work.

Graduating—Complete equipment for accurate calibration and excellent finish.

Note—Where quantities permit we are prepared to undertake the manufacture of special work falling generally within the classifications indicated above.

KIMBLE GLASS

In formulating a glass for use in the manufacture of laboratory apparatus important properties such as chemical resistance, thermal resistance and lamp working qualities must be considered. No single type of glass has yet been discovered possessing all of these qualifications. The Kimble Glass Company therefore manufacture two distinct types of glass, i. e., (1) Kimble Soda Lime Glass, for general apparatus purposes, designed particularly for ease of working and reworking over lamps. It possesses the greatest chemical and thermal resistance that is possible in combination with the foregoing quality. Items of Kimble manufacture regularly made of this type of glass are: Hydrometer Jars, Graduated Ware, Chemical Funnels, Condensers, Potash Bulbs, etc. (2) Kimble Resistance Glass for such items as Beakers, Boiling Flasks, Petri Dishes and Biological Containers such as Ampoules, Serum Vials, etc. This glass is designed to offer the highest Thermal Resistance and greatest possible Chemical Resistance and will withstand repeated sterilization and autoclaving.

PLANT AT VINELAND, N. J.

MAURICE A. KNIGHT

Acid Proof Chemical Stoneware

AKRON, OHIO

New York Office
404 World Building
Fred M. Klein, Mgr.

KNIGHT-WARE
"IT IS THE BODY ITSELF"

Philadelphia Office
1228 Spruce Street
E. B. Wilson, Mgr.

Authorities in equipping modern laboratories have realized the necessity of installing into their laboratories equipment that will be best capable of withstanding all existing conditions.

KNIGHT-WARE equipment answers their purposes. It is a permanent, acid resisting, inexpensive and GUARANTEED Acid Proof Chemical Stoneware, ideal for Sinks, Waste Lines and Ventilating Lines in High School, College and University Laboratories, Hospitals and Commercial Plant Laboratories.

A few of our more recent KNIGHT-WARE installations follow:

JOHNS HOPKINS UNIVERSITY
Chemistry Laboratory
Baltimore, Maryland

JOHNS HOPKINS UNIVERSITY
Hygiene Building
Baltimore, Maryland

WEST VIRGINIA UNIVERSITY
Hall of Chemistry
Morgantown, W. Va.

COLUMBIA UNIVERSITY
Chemistry Building
New York City

COLUMBIA PRESBYTERIAN
Hospital Centre
New York City

NEW YORK UNIVERSITY
Chemistry Building
New York City

DETROIT UNIVERSITY
Chemistry Building
Detroit, Michigan

*OHIO STATE UNIVERSITY
Chemistry Building
Columbus, Ohio

DUKE UNIVERSITY
Chemistry Building
Durham, N. C.

McGILL UNIVERSITY
Pulp & Paper Research Bldg.
Montreal, Quebec, Canada

*PRINCETON UNIVERSITY
Chemistry Building
Princeton, N. J.

* Buildings under construction at this time and KNIGHT-WARE being supplied.

We shall be pleased to submit names of Architects, Engineers and Contractors upon request.

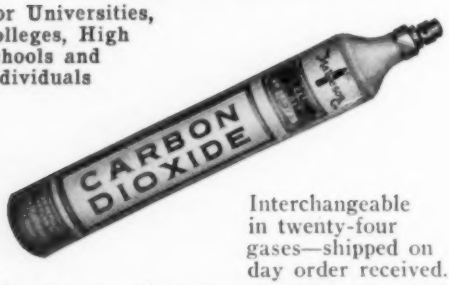
THE MATHESON CO.

NORTH BERGEN, NEW JERSEY

Gas Department

THE LECTURE BOTTLE

For Universities, Colleges, High Schools and Individuals



Interchangeable in twenty-four gases—shipped on day order received.

On account of its convenience it has become Standard Laboratory equipment. It does not need a regulator—its valve being delicate enough to permit close adjustment without one. Ask for Bulletin III.

LABORATORY GASES

We can supply 24 different gases for Laboratory use in five sizes of containers.
Ask for Bulletin II.

LABORATORY AUTOMATIC REDUCING REGULATORS

Needle Valve Outlet and Hose Connection, also supplied with single gauge.

For Oxygen, Hydrogen, Nitrogen, Carbon Dioxide, Argon, Helium, Nitrous Oxide and other gases. Close register on low working pressures.
Ask for Bulletin IV.

Apparatus Department

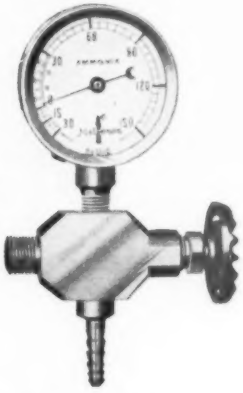
GASOMETER EQUIPMENT FOR LIQUID HYDROGEN SULFIDE SUPPLY

For classroom use ask for Bulletin I.

For individual use see Bulletins II and III.

GASOMETERS are now the accepted form of sulfuretted Hydrogen supply. Available in 5 sizes of cylinders.

AMMONIA REGULATOR (Non-Automatic)



Permits quick and easy adjustment of flow to less than one bubble per second up to full flow.
Ask for Bulletin IV.

NON-AUTOMATIC NEEDLE VALVE

For use with all kinds of gases.
Permits quick and easy regulation for use where a Gasometer is not desirable.

RUBBER TUBING

We carry in stock large supply of rubber tubing in six sizes, 2 weights and three colors. This tubing is specially prepared for use with laboratory gases.

R & H PLATINUM WORKS, INC.

709 Sixth Avenue, NEW YORK, N. Y.

R & H PLATINUM WARE

FOR

ALL LABORATORY PURPOSES

R & H Platinum Works, Inc., specializes in the manufacture of the highest types of Platinum Laboratory Ware. The excellence of this Ware is due to almost half a century of experience in the refining and working of precious metals.

It is particularly suitable for educational institutions. The highest standards both as to purity of material and expert workmanship are maintained. As a result, R & H Platinum Ware gives long and satisfactory use.

Everything in Platinum for the Laboratory may be secured from us . . . Crucibles, Dishes, Apparatus, Utensils, Electrodes, Wire, Foil, Alloys, Salts, etc. Also Gold and Silver for the Laboratory. In addition to our regular line we can supply any type of Platinum apparatus, made exactly to your specifications.

Send used Platinum and other precious metal ware to us for reworking or exchange. Our modern equipment and careful refining methods assure you of the best returns.

Every college and school should have a copy of the R & H Catalogue. In addition to descriptions and illustrations of Laboratory Ware it contains useful facts regarding the care and cleaning of Platinum Ware. Please request your copy.

E. H. SHELDON & COMPANY

MUSKEGON, MICHIGAN

Manufacturers of

LABORATORY, HOME ECONOMICS

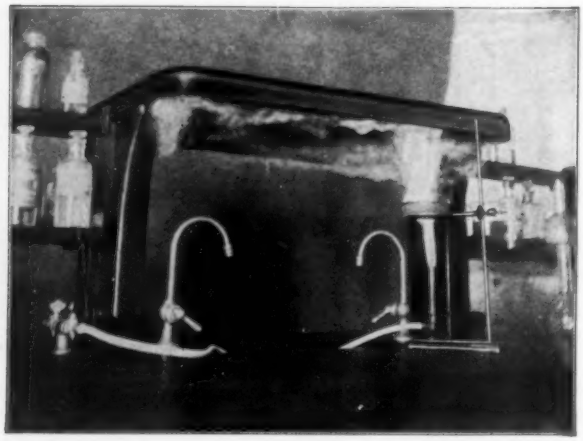
and

VOCATIONAL SCHOOL FURNITURE

SHELDON NO. 1000 TABLE WITH TABLE FUME HOOD

The illustration at the right shows Sheldon No. 1000 Chemistry Table accommodating four classes. It is equipped with the Sheldon Patented Table Fume Hood, a new and highly satisfactory method of fume removal developed by the Sheldon Company. The illustration below is reproduced from an actual photograph showing the Sheldon Fume Hood in action. Write asking for complete information.

CLOSE-UP OF SHELDON PATENTED TABLE HOOD IN ACTION



The above unretouched photograph shows the action of the Sheldon hood in removing smoke or fumes. The arrangement is such that a curtain or baffle of swiftly moving air is formed around the perimeter of the hood. The air curtain cuts off the escape of fumes that are formed beneath the hood and carries them through a narrow opening into the exhaust duct. The hood normally removes approximately 200 cubic feet of air per minute. Shuttered openings are provided where the two exhaust ducts pass through the table for the removal of gases heavier than air.

WIDE SELECTION OF FURNITURE OF PROVEN QUALITY

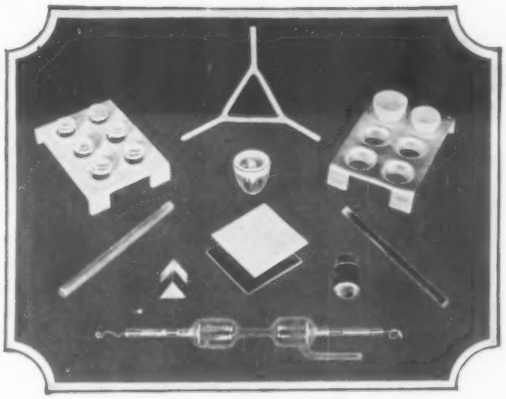
100	types of	Chemistry Tables
10	" "	Physics and Chemistry Tables
20	" "	Physics Tables
15	" "	General Science Tables
25	" "	Biology Tables
6	" "	Medical Tables
16	" "	Domestic Science Tables
17	" "	Sewing Tables
50	" "	Manual Training Benches
9	" "	Art Tables
12	" "	Drawing Tables
27	" "	Cases and Cabinets
6	" "	Commercial Tables
28	" "	Auxiliary Furniture

The complete Sheldon Line is illustrated and described in Catalog No. 22 mailed free to those interested.

THE THERMAL SYNDICATE, LTD.

1720 ATLANTIC AVENUE, BROOKLYN, NEW YORK

VITREOSIL



Fused Pure Silica and Fused Pure Quartz

LABORATORY WARES

There is a shape and quality of vitreosil for every purpose and the highest order of work assumes its use. Yet vitreosil, giving a greater period of usefulness, is not expensive in the long run, and in cases where it serves as a reliable substitute for platinum, it is even lower in initial cost.

The properties of vitreosil laboratory ware are such as to include a wide range and ever increasing scope of usefulness to the chemist, physicist, metallurgist, and those engaged in the allied sciences.

USE VITREOSIL

When you desire a material having a low thermal expansion or one that is the least soluble of any known substance.

When absolute resistance to corrosive gases and liquids is essential.

When good electrical insulation is expected even at a bright red heat.

When transparency to the spectrum is required in the infra red region as well as in the ultra-violet down to 2000 Angstroem units and in the intermediate spectrum.

When a non-porous material is necessary at high temperatures.

When you require utensils that will remain constant in weight throughout your investigations.

ESPECIAL ATTENTION IS DRAWN TO THE FOLLOWING NEW DEVELOPMENTS

Transparent vitreosil crucibles with ground-in capsule or crucible covers for the determination of volatile and combustible matter in coal and coke respectively.*

Muffle trays to accommodate the above crucibles in all sizes suggested by the ASTM and for standard vitreosil crucibles.*

Special shapes to accurate specifications for electrical insulation.

Transparent vitreosil plate of unusually heavy thickness for blocks, prisms, lenses, etc.*

* See illustration.

Obtainable through all dealers or direct from us. Write for descriptive literature.

WESTON ELECTRICAL INSTRUMENT CORP.

591 Frelinghuysen Avenue, NEWARK, N. J.

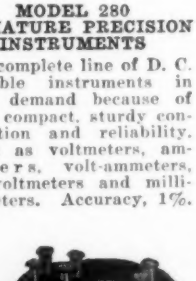
Albany	Cleveland	Knoxville	Pittsburgh	Seattle
Atlanta	Dallas	Los Angeles	Portland	Spokane
Boston	Denver	Minneapolis	Rochester	Syracuse
Buffalo	Detroit	New Orleans	St. Louis	Tacoma
Chicago	Houston	New York	San Antonio	Tampa
Cincinnati	Jacksonville	Philadelphia	San Francisco	

THE WORLD'S SCIENTIFIC STANDARDS

Wherever electrical tests are made, there is no single measurement which does not derive its authenticity, somewhere in the process, from an original Weston discovery or development. The use of Weston instruments in school and science laboratories has become as thoroughly established as the art of measurement itself. It is a fixed principle that only "Westons" should be used in the study of electrical science just as Ohm's Law is a fundamental part of the student's educational groundwork. Only the most exacting standards of accuracy and the highest expressions of craftsmanship should be offered the student as inspirational examples of the precise work which makes for progress and success in the electrical profession. And that means "Westons"—the instrument standards of the world. Following are a few of the Weston models which are particularly recommended for school equipment.

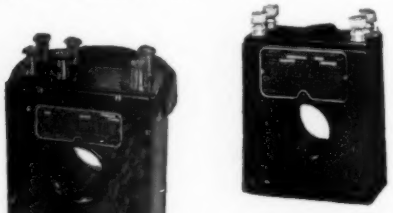
MODEL 280
MINIATURE PRECISION INSTRUMENTS

A complete line of D. C. portable instruments in wide demand because of their compact, sturdy construction and reliability. Made as voltmeters, ammeters, volt-ammeters, millivoltmeters and milliammeters. Accuracy, 1%.



MODEL 375
STUDENT GALVANOMETER

Portable type — durable —reasonably sensitive, and moderately priced. Resistance, approximately 25 ohms. Size, 3½" x 3¼" x 3½". Mounted on handsome base and finished in dull black japan.



MODEL 461
PORTABLE CURRENT TRANSFORMER

For use with Model 433 portable ammeter shown in the illustration below. For general testing where compactness and portability are essential. Maximum secondary burden, 5 volt-amperes. Frequency, 25 to 133 cycles.

MODEL 539
NEW MINIATURE CURRENT TRANSFORMER

For use with Model 528 portable A. C. ammeter shown in the illustration below. Contained in mottled black and red bakelite case to match. A marvelously constructed portable instrument for compactness and convenience in testing. Used in connection with a one-ampere instrument, it is possible to measure currents from 0.2 amp. to 200 amps.

THE "JUNIOR" LINE OF A. C. PORTABLE PRECISION INSTRUMENTS

Model 433 single, double and triple range voltmeters—and single and double range ammeters and milliammeters. Black bakelite cases, shielded from external magnetic fields. For general A. C. testing where light and compact instruments are desired.

MODELS 528 AND 489 MINIATURE PORTABLE A. C. AND D. C. INSTRUMENTS

A handy miniature line of wide utility, accuracy 2%. For D. C. service made as single and double range ammeters and double and triple range voltmeters, with self-contained resistances of 1000 or 125 ohms per volt. For A. C. service made as double and triple range voltmeters and single range ammeters and milliammeters. Excellent electrical characteristics and incomparable workmanship. Bakelite cases.

MONOGRAPH B-7 FREE TO SCIENCE INSTRUCTORS

Containing a full exposition of the principles of the Permanent Magnet Movable Coil and Movable Iron types of instruments, together with a treatise on experimental electrical testing and innumerable examples.

THE CENTRAL SCIENTIFIC COMPANY

has been appointed wholesale distributor and service bureau to educational institutions. Weston instruments can be obtained from the leading apparatus dealers in whose catalogs they will be found listed.

Section VII

CHEMICAL INDEX

The following index lists the chemicals currently used in the laboratory and research work of schools and colleges, together with the names of some of the principal suppliers. Addresses and additional information will be found on pages 332 to 340.

The grades in which the manufacturers state that they are prepared to furnish their chemicals have been classified as follows:

1 — *Manufacturer's highest grade of reagent chemicals (C. P. grade).*
2 — *A grade suitable for most laboratory uses, although below C. P. quality (U. S. P. grade).*
3 — *A good commercial quality (Technical grade).*

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co. ○	General Chemical Co.§	Grasselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Acacia (Gum Arabic)	1	....	....	....	....	....	
Acetaldehyde	....	1-2	....	....	....	1	
Acetamide	2	1	....	....	2	1	
Acetanilide (Antifebrin)	2	1	....	....	2	1	
Acetic Anhydride	1-2-3	1-2	1	....	1*-1	1	
Acetone	1-2	1-2	1-2-3	....	1*-1	1	
Acetphenetidin (Phenacetin)	2	1	....	....	2	....	
Acetyl Chloride	....	2	1-2	....	....	1	
Acid Acetic, Glacial 99.5%	1-2	1	1-2-3	1	1*-1	1-2	
Acetic Glacial Conf. to Dichromate Test	1	....	1	....	1*	1	
Acetic, Spec. for Shellac Anal	1	....	1	....	....	....	
Acetic 36%	2	....	2	....	1*-1-2	1-2	
Arsenic H_3AsO_4	....	....	1	....	1	....	
Acetylsalicylic (Aspirin)	2	1	....	....	2	....	
Anthranilic	....	1	....	....	....	....	
Arsenic	1-2	....	1	....	2	1	
Arsenious	1-2-3	....	1	....	1*-1	1	
Benzoic	1-2	1	....	....	1*-1	1	
Boric, Cryst. & Po.	2	....	....	....	1	1	
Boric, Cryst.	1	....	1	....	1*	1	
Boric, Anhyd.	....	....	....	....	1*	1	
Butyric	1	1-2	....	....	2	1	
Carbolic, Cryst.	1-2	1	1-2	....	1*-1	1	
Carbolic, Liquid	2	....	....	....	2	1	
Chloroacetic (di-Mono-Tri-)	....	1	....	....	....	1	
Chloroplatinic	1	....	1	....	....	1	
Chromic	1-2-3	....	1-2	....	1*-1	1	
Cinnamic	....	1	....	....	2	....	
Citric, Cryst.	1	1	1	....	....	1	
Citric, Cryst. & Po.	1-2	....	....	....	1*-1-2	1	
Formic, About 85%	1-2-3	2	(90 & 50%) 1	....	1	1	
Gallic	2	1	....	....	1*-2	1	
Glycerophosphoric	....	....	....	....	2	....	
Hippuric	....	1	....	....	3	....	
Hydriodic	2	2	....	....	3	1	
Hydrobromic 40%	....	2	(42%) 1	....	1*-1	1	
Hydrobromic 34%	1-2	....	....	....	....	....	
Hydrochloric (Muriatic)	3	....	1-2-3	3	2-3	3	
Hydrochloric Sp. Gr. 1.18-1.19	1	....	1	1	1*-1-2	1-2	
Hydrochloric fr. fr. Arsenic	1	....	1	1	1*	1	
Hydrocyanic	....	....	....	....	2	....	
Hydrofluoric	1-3	....	3	....	2	2-3	
Hydrofluoric 48%	3	....	1-3	....	1*-1	1-2-3	
Hydrofluoric 52% & 60% & Etching Acid	....	....	2	....	....	....	
Hydrofluorsilic, 27-30%	1	....	1	....	1	1-3	
Hydrophosphorous	....	....	....	....	2	....	
Hypophosphorous	1-2	....	....	....	2	....	
Iodic, Cryst.	1	....	1	....	1	1	
Iodic, Anhydr.	1	....	....	....	2	1	

† "C. P. Baker's Analyzed" Chemicals are indicated as No. 1.
§ The General Chemical Co. have used No. 1 to indicate their Baker & Adamson Reagent Quality and No. 2 the Baker & Adamson Fine Chemicals.
* Merck & Co., Inc.'s "Blue Label Reagents."
○ Eastman Grade No. 1 is specified on the basis of boiling, melting or decomposition temperatures.

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co.	General Chemical Co.§	Grasselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Acid Lactic, 85%	1-2	2	1	....	1*-1-2	1	
Malic	....	1	....	....	2	....	
Malonic	....	1	....	....	....	....	
Molybdic, 85%	1-2	....	1	....	1*-1	1	
Molybdic, Anhydr., 99.5-100%	1	....	1	....	1*-1	1	
Monochloracetic	2	1	....	....	1	1	
Nitric, Sp. Gr. 1.42	1	....	1-3	1-3	1*-1-2	1-3	
Nitric, Fuming	1	....	1	3	1	1	
Nucleic	....	1	....	....	3	....	
Oleic	2	2	2	....	2	....	
Osmic	....	1	....	....	2	....	
Oxalic, Cryst.	1-2	1	1-2	....	1*-1-2	1	
Perchloric 60%	1	1	....	....	1	1	
Perchloric 20%	1	....	1	....	1	1	
Phosphomolybdic	1	....	....	....	1	1	
Phosphoric, 85%	1-2	....	1-2	....	1*-1-2	1	
Phosphoric (Glacial) Meta Sticks	1	....	....	....	1*-1	1	
Phosphoric, Anhydr.	1	....	1	....	1*-1	1	
Phosphorous C. P. Cryst.	....	....	1	....	....	....	
Phosphotungstic, Cryst.	1-2	....	....	....	1	1	
Phthalic, Anhydr	1-2	1	....	....	1	1	
Picric	1	1-2	1	....	1-2	1	
Picramic	1	1	....	....	....	....	
Propionic	....	1	....	....	....	1	
Pyrogallic	1-2	....	1	....	1-2	1	
Pyroligneous	2	....	....	....	2	....	
Rosolic	1	....	....	....	1*	....	
Salicylic	1-2	1	1	....	1-2	1	
Selenic and Selenious	....	....	....	....	....	1	
Silicic	1	....	....	....	1	1	
Silicotungstic	1	....	....	....	1	1	
Stearic	2	1-2	1	....	2	1	
Succinic	1-2	1	....	....	1	1	
Sulphanilic	1-2	1	1	....	1	1	
Sulphosalicylic	....	1	....	....	1	....	
Sulphuric	1-2-3	....	1-3	1-3	1*-1-2	1	
Sulphurous	1	....	1	....	1*-1	1	
Tannic	1-2	....	1	....	1-2	1	
Tartaric, Cryst.	1	1	1	....	1-2	1	
Tartaric, Po.	1-2	....	1	....	1-2	1	
Trichloracetic	1-2	1	....	....	1	1	
Tungstic	2	....	....	....	2	1	
Valeric	....	1	....	....	2	....	
Aconitine	....	....	....	....	2	....	
Adeps Lanae	....	....	....	....	2	....	
Agar-Agar	2	....	....	....	2	1	
Agaricin	....	....	....	....	2	....	
Albumin, Egg	1	....	....	....	2	....	
Alcohol, Amyl	1-2	1	1	....	1*-1	1	
Benzyl	....	1	....	....	1	....	
Butyl	....	1-2	....	....	....	....	
Capryl	....	1	....	....	....	....	
Ethyl, Absolute, 99.8-100%	1	....	....	....	....	....	
Iso-Butyl	....	1	....	....	....	....	
Isopropyl	....	1	....	....	....	....	
Methyl, 95%	1-(97%)	1	2	....	2	1-2	
Methyl, Absolute Acetone Free	1	1	1	....	1*-1	1	
Alizarine Paste	....	3	....	....	2	....	
Alloys, Devardes, for Reductions	....	....	1	....	1*	1	
Aloin	2	....	....	....	2	....	
Alpha-Naphthylamine	....	1-2	....	....	2	1	
Alum, Ammonium	1-2	....	1-2-3	....	1-2	1	
Ammonium Chrome	2-3	....	1	....	2	1	
Ammonium Potash	....	....	....	....	1-2-3	1	
Potash Chrome	....	....	....	....	2	1	
Aluminum (Metal)	1	....	1	....	2	1	
Acetate	1-2	....	1	....	1	1	
Chloride, Hydrated	....	....	1	3	1	1	
Chloride, Anhydrous	1	....	1	....	1	1	
Fluoride	1	....	1	....	1	1	

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co.	General Chemical Co.§	Grasselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Aluminum Hydroxide	1	....	1	....	1	1	
Nitrate	1-2	....	1	....	1	1	
Oxide, Ignited	1-2	....	1	....	1	1	
Phosphate	1	....	....	....	1	1	
Potassium Sulphate	1-2	....	1-2-3	....	1-2	1	
Sodium Sulphate	1-2	....	....	....	2	1	
Sulphate	1-2-3	....	1-2-3	3	1-2	1	
Aluminum & Ammonium Sulphate, Cryst	1	....	1-2	....	1-2	1	
Aluminum & Potassium Sulphate, Cryst	1	....	1-2	....	1-2	1	
Amidopyrine	....	....	....	....	2	....	
Ammonia, Anhydr	....	....	....	3	....	....	
Ammonia Water 28%	3	....	3	3	1*-1-2	1-2-3	
Ammonium Acetate	2	....	1	....	1*-1	1	
Arsenate	1	....	....	....	....	1	
Benzoate	2	....	....	....	2	1	
Bicarbonate	1-2	....	....	....	2	1	
Bichromate	1-2-3	....	1	....	1-2	1	
Bifluoride	2	....	....	....	1	1	
Bisulphate	1	....	....	....	1	1	
Bisulphite	1	....	1	....	2	1	
Bitartrate	1	....	....	....	2	1	
Borate	1-2	....	....	....	2	1	
Bromide	1-2	....	1	....	1-2	1	
Carbonate, Cubes	1	....	1	....	1-2	1	
Carbonate, Lumps	1	....	1	....	1-2	1	
Chloride, Gran	1	....	1-2	3	1*-1-2	1	
Chromate	1-2	....	....	....	1	1	
Citrate	1-2	....	....	....	1	1	
Dichromate	2-3	....	....	....	1-2	1	
Fluoride	1-2	....	1	....	1	1	
Formate	1	....	1	....	1	1	
Hypophosphite	....	....	....	....	2	1	
Hydroxide	1-2-3	....	1-2	1-3	1*-1-2	1	
Iodide	1-2	....	....	....	1-2	1	
Molybdate	1-2	....	1	....	1*-1-2	1	
Nitrate	1-2-3	....	1-2-3	....	1*-1-2	1	
Oxalate	1-2	....	1-2	....	1*-1	1	
Persulphate	1-2	....	1-2	....	1*-1-3	1	
Phosphate Monobasic	1-2-3	....	1	....	1	1	
Phosphate Dibasic	1-2-3	....	1	....	1*-1	1	
Phospho-Molybdate	1	....	....	....	2	1	
Salicylate	2	....	....	....	2	1	
Sulphate	1-2-3	....	1-2-3	....	1*-1	1	
Sulphocyanate	....	....	1	....	1*-1	1	
Sulphide Solution	1	....	1-2	3	1-3	1	
Tartrate	1-2	....	1	....	1	1	
Valerate	....	....	....	....	2	....	
Amygdalin	....	....	....	....	2	....	
Amyl Acetate	2	1-3	....	....	2	1	
Alcohol	....	1	1	....	1*-1	1	
Butyrate	....	3	....	....	2	....	
Nitrate	....	1	....	....	2	....	
Salicylate	....	1	....	....	2	....	
Valerate	....	3	....	....	2	....	
Analytical Chemicals	1-2-3	1	1-2-3	....	1-2-3	1	
Anethol	....	1	....	....	2	....	
Aniline	....	1-2	1	....	1-3	1	
Hydrochloride	1-2	1	1	....	1	1	
Sulphate	....	1	....	....	2	1	
Anthracene	1	1-3	....	....	....	1	
Anthraquinone	....	1	....	....	....	....	
Antimony, Metal	1	....	1	....	2	1	
Chloride	1	....	....	....	1	1	
Oxide	1	....	1	....	2	1	
Potassium Tartrate	1-2	....	1	....	2	1	
Sulphate	1	....	1	....	1	1	
Antipyrine	....	....	....	....	2	....	
Apomorphine-Hydrochloride	....	....	....	....	2	....	
Arbutin	....	....	....	....	2	....	
Arabinose	....	....	....	....	2	....	

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co	General Chemical Co.§	Grasselli Chemical Co.	Merck & Co Inc.	Sterling Products Company	
Arecoline Hydrobromide	....	....	....	....	....	....	
Arsenic, Metal	1	....	1	....	2	1	
Bromide	....	....	....	....	2	1	
Sulphide	1	....	....	....	2	1	
Trioxide	1-2-3	....	1	....	1*-1-2	1	
Arsphenamine	....	....	....	....	2	....	
Asbestos	1	....	1	....	....	1	
Asparagin, Pure	....	....	....	....	2	....	
Atropine and Salts	....	....	....	....	2	....	
Azolitmin	....	....	....	....	1*	....	
Balsam, Fir, Canada	1	....	....	....	....	....	
Peru	....	....	....	....	2	....	
Barium Acetate	1-2	....	1	....	1	1	
Bromate	....	....	....	....	....	1	
Bromide	....	....	....	....	2	1	
Carbonate	1-2-3	....	1	....	1*-1	1	
Chlorate, Cryst	2	....	1	....	1	1	
Chloride, Cryst	1-2-3	....	1-2-3	3	1*-1	1	
Chromate	1	....	....	....	....	1	
Dioxide	1-2	....	1	....	1	1	
Fluoride	1	....	1	....	1	1	
Hydroxide, Cryst	1-2-3	....	1	....	1*-1-2	1	
Hydroxide, Dried	1-2	....	....	....	1*-1	1	
Nitrate, Cryst	1-2	....	1	....	1*-1-2	1	
Peroxide	1-2	....	....	....	2	1	
Sulphate (not X-ray)	1-2	....	1	....	2	1	
Sulphide	2	....	....	....	2	1	
Sulphite	1	....	....	....	....	1	
Benedict's Qualitative Solution	....	....	....	....	2	....	
Benzaldehyde	2-3	1	....	....	1-2	1	
Benzene	1-2	1-2	1-2-3	....	1*-1-2	1	
Benzidine	1	1-2	....	....	1	....	
Benzoyl Chloride	1	1	....	....	2	1	
Benzyl Alcohol	....	1	....	....	1-2	....	
Benzoate	1	1	....	....	2	....	
Chloride	1	1-2	....	....	2	....	
Benzin	1	....	....	....	1*-1	....	
Beta-Naphthol	2	1-3	1	....	2	1	
Beta-Naphthol Benzoate	....	1	....	....	2	1	
Beta-Naphthylamine	....	1-3	....	....	....	1	
Bismuth, Metal	1	....	1	....	1-2	1	
Acetate	1	....	....	....	....	1	
Beta-Naphthol	....	....	....	....	2	....	
Chloride	1-2	....	1	....	1	1	
Citrate	....	....	....	....	2	1	
Nitrate	1-2	....	1	....	1	1	
Oxide, Hydr.	1	....	....	....	1	....	
Oxychloride	1-2	....	....	....	1	....	
Subnitrate	1-2	....	1	....	1-2	1	
Subcarbonate	1-2	....	....	....	1-2	1	
Subgallate	2	....	....	....	2	1	
Subsalicylate	....	....	....	....	2	....	
Bleaching Powder	1-2	....	3	3	....	1-3	
Bromine	1-2	....	1	....	1*-1-2	1	
Bromphenol Blue	....	1	....	....	....	....	
Bromoform	2	1	....	....	1-2	....	
Bromthymol Blue	....	1	....	....	....	....	
Brucine	....	....	....	....	2	....	
Butyl Alcohol	....	1-2	....	....	2	....	
Butyl Chloral Hydrate	1	....	....	....	2	....	
Cadmium (Metal)	1	....	1	1-3	2	1	
Acetate	1-2	....	....	....	1	1	
Bromide	1-2	....	....	....	2	1	
Carbonate	1-2	....	1	....	1	1	
Chloride	1-2	....	1	....	1-2	1	
Iodide	1	....	....	....	2	1	
Nitrate	1-2	....	1	....	1-2	1	
Potassium Iodide	....	....	....	....	....	1	
Sulphate	1-2	....	1	....	1-2	1	
Caffeine	2	1	....	....	2	....	

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co.	General Chemical Co.§	Graselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Caffeine Citrated	2	....	....	....	2	....	
Calamine	2	....	....	....	2	....	
Calcium (Metal)	1	....	....	....	2	....	
Acetate	1–2–3	....	1	....	1–2	1	
Arsenate	1	....	....	3	3	1	
Arsenite	....	....	....	....	3	1	
Bromide	1–2	....	....	....	1	1	
Carbide	1	....	2	....	....	1	
Carbonate	1–2	....	1–2	....	1*–1–2–3	1	
Chloride, Cryst.	1	....	1	....	1	1	
Chloride, Dry	1–2–3	1	1–2	3	1–2	1	
Fluoride	1–2	....	1–2	....	1	1	
Formate	1–2	....	....	....	1	1	
Glycerophosphate	1–2	....	....	....	2	....	
Hypochlorite	1–2	....	3	....	....	1–3	
Hypophosphite	1	....	....	....	2	1	
Iodide	1–2	....	....	....	2	1	
Lactate	2	....	1	....	2	1	
Lactophosphate	1	....	....	....	2	....	
Nitrate	1–2	....	1	....	1	1	
Oxalate	1–2	....	....	....	2	1	
Oxide	2	....	1–2	....	1*–2	1	
Phosphate, Primary	1	....	1	....	1–2	1	
Phosphate, Secondary	1–2	....	1	....	1–2	1	
Sulphate	1–2–3	....	....	....	1–3	1	
Sulphide	2	....	....	....	2	1	
Sulphocarbolate	1	....	....	....	2	....	
Calomel	1–2	....	....	....	1*–1–2	1	
Camphor	2	1	....	....	....	1	
Monobromated	2	1	....	....	2	....	
Carbon	1	....	....	....	....	1	
Decolorizing (Activated Charcoal)	1	1	1	....	....	2–3	
Disulphide	1–2–3	....	1–2–3	....	1*–1–2	1	
Tetrachloride	1–2–3	1–2	1–2–3	....	1*–1–2	1	
Carborundum	1	....	....	....	....	3	
Carmine	....	....	....	....	1*	....	
Casein	3	1	....	....	3	....	
Catechol	....	1	....	....	....	....	
Cerous Oxalate	....	....	....	....	2	....	
Cotyl Alcohol	....	1	....	....	....	....	
Charcoal	1	....	1	....	2	1–3	
Chemicals, Analytical	....	....	1–2	....	....	1	
for Reagent or Laboratory Purposes	....	1	1–2	....	1–2	1	
Chloral Hydrate	2	1	....	....	2	1	
Chloramine	....	1	....	....	....	....	
Chlorphenol, Red	....	1	....	....	....	....	
Chloroform	1–2	1	1–2	....	1*–1–2	1	
Chlorophyll	....	....	....	....	2	....	
Cholesterol	....	1	....	....	2	....	
Chromium Chloride	1–2	....	1	....	1	1	
Nitrate Solution	1	....	....	....	2	1	
Oxide	1	....	....	....	1*–1	1	
Potassium Sulphate, Cryst.	1–2–3	....	1–2	....	1*–1–2	1	
Sulphate	1–2	....	1	....	2	1	
Trioxide	1–2–3	....	1–2	....	1*–1–2	1	
Cinchona Bark	....	....	....	....	2	....	
Cinchonidine	1	....	....	....	2	....	
Cinchonine	....	1	....	....	2	....	
Cinnamic Aldehyde	....	1	....	....	2	....	
Cobalt (Metal)	1	....	....	....	2	1	
Acetate	1	....	....	....	1	1	
Carbonate	1	....	....	....	2	1	
Chloride	1–2	....	1	....	1	1	
Nitrate	1–2	....	1	....	1*–1	1	
Oxide	1–2	....	1	....	2	1	
Sulphate	1–2	....	....	....	1	1	
Cocaine	....	....	....	....	2	....	
Cochineal	1	....	....	....	....	1	
Codeine	....	....	....	....	2	....	
Colchichine	....	....	....	....	2	....	

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co.	General Chemical Co.§	Grasselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Collodion	2	....	....	....	1-2	....	
Colloidal Iron	....	....	....	....	2	....	
Commercial Chemicals	1-2-3	....	2-3	....	3	....	
Congo Red	1	....	....	....	1*	1	
Copper (Metal)	1	....	1	....	1	1	
Acetate	1-2-3	....	1-2	....	1	1	
Ammonium Chloride	1-2	....	1	....	1*-1	1	
Arsenate	1	....	....	....	2	1	
Arsenite	1-2	....	....	....	2	1	
Bromide	1-2	....	1	....	1	1	
Carbonate	1-2-3	....	1	....	1	1	
Chloride	1-2	....	1	....	1*-1	1	
& Potassium Chloride	1	....	1	....	1	1	
Iodide	2	....	....	....	2	1	
Nitrate	1-2-3	....	1	....	1-2	1	
Oxalate	1-2	....	....	....	2	1	
Oxide, Black Gran.	....	....	....	....	1	1	
Oxide, Black Powd.	1-2-3	....	1	....	1*-1	1	
Oxide, Red Powd.	1-2-3	....	1 2	....	1	1	
Oxide, Wire Form	....	....	1	....	1	1	
Phosphate	1	....	....	....	2	1	
Sulphate, Crys.	1-3	....	1-2-3	3	1*-1-2-3	1	
Sulphate, Powd. Anhyd.	1-2	....	1	3	1	1	
Coumarin	....	1	....	....	2	....	
Creosote (Wood Creosote)	2	....	....	....	2	....	
Carbonate	2	....	....	....	2	....	
Cresol	2	2	....	....	2	....	
Cupferron	....	1	1	....	....	1	
Curcumin	....	1	....	....	....	....	
Daturine and Salts	....	....	....	....	2	....	
Dextrin	3	1-2-3	....	....	1-2	1	
Dextrose, "C.P." Anhyd.	1	1-2	1	....	1	1	
Devardas Metal	....	....	1	....	1*	1	
Dichloramine	....	1	....	....	....	....	
Diethyl Phthalate	....	1	....	....	....	....	
Dimethylamine Benzaldehyde	....	1	....	....	....	....	
Dimethylgloxime	2	1	1	....	1*	1	
Dimethylsulphate	2	2	2	....	....	1	
Diphenylamine	2	1-2	1	....	1*	1	
Dipotassium Hydrogen Phosphate	....	....	....	....	1*	1	
Dulcit	....	....	....	....	2	....	
Egg, Albumin	....	....	....	....	2	1	
Ergotin	....	....	....	....	2	....	
Eschka's Mixture	....	....	1	....	1*	1	
Eserine	....	....	....	....	2	....	
Ether (Sulphuric Ether)	2	....	2	....	1*-2	1	
U.S.P. for Anaesthesia	2	....	....	....	2	2	
Anhydrous, Distilled over Sodium	1	1	1	....	1*-1	1	
Petroleum (Ligroin)	....	....	1-2	....	....	1-2-3	
Ethyl Acetate	1-2	1-2	1	....	1-2	1	
Acetoacetate	....	1	....	....	....	....	
Benzoate	....	1	....	....	2	1	
Bromide	2	1	1	....	1	1	
Butyrate	3	1-3	....	....	2	....	
Chloride	....	1	....	....	....	....	
Ethylhydrocupreine	....	....	....	....	2	....	
Ethyl Iodide	2	1	....	....	2	....	
(Iso) Valerate	....	1	....	....	2	....	
Pelargonate	....	1	....	....	....	....	
Propionate	....	1-3	....	....	....	....	
Salicylate	....	1-2	....	....	2	....	
Ethylene Dichloride	....	1	....	....	....	....	
Glycol	....	1	....	....	....	....	
Eucalyptol	....	....	....	....	2	....	
Eugenol	....	1-2	....	....	2	....	
Filter Paper	1	....	1	....	....	1	Eaton-Dikeman Co.
Formaldehyde	....	2	2	....	1*-2	1	
Furfural	....	1-2	....	....	2	1	
Galactose	....	1	....	....	2	....	
Gelatin	1	....	....	....	....	....	

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co.	General Chemical Co.§	Grasselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Galena Crystals	1	....	....	....	....	....	....
Glass Wool	1	....	1	....	2	1	....
Glucose, Pure	3	1	....	....	1	....	....
Glycerin	1–2	1	1	....	1*–1–2	1	....
Gold Bromide	....	....	....	....	2	....	....
Chloride	2	....	....	....	2	....	....
& Sodium Chloride	....	....	....	....	2	....	....
Guaiacol	2	1–3	....	....	2	....	....
Carbonate	2	....	....	....	2	....	....
Gums (All kinds)	1	....	....	....	....	....	....
Gypsum	1	....	....	....	....	....	....
Heliotropin	....	1	....	....	2	....	....
Hematoxylin	....	1	....	....	....	....	....
Hexamethylenetetramine	....	1	....	....	2	....	....
Hide, Powder	1	....	....	....	....	1	....
Histamine (Ergamine Acid Phosphate); Histiline Dichloride	....	1	....	....	....	....	....
Homotropine	....	....	....	....	2	....	....
Hydrastine	....	....	....	....	2	....	....
Sulphate	....	....	....	....	2	....	....
Hydrazine Sulphate	....	1	....	....	1*–2	....	....
Hydrogen Ion Indicators	....	1	....	....	....	....	La Motte Chemical Products Co.
Peroxide	1–2	....	1–2	....	2	1	....
Sulphide Water	....	....	....	....	2	1	....
Hydroquinone	....	1	....	....	2	....	....
Hydroxylamine Hydrochloride	2	1	....	....	1*	....	....
Hyoscine (Scopolamine)	....	....	....	....	2	....	....
Ichthyol	....	....	....	....	2	....	....
Indicators, Oxidation-Reduction	....	1	....	....	....	....	La Motte Chemical Products Co.
Indigo, Carmine	1	....	....	....	2	....	....
Inulin	....	....	....	....	2	....	....
Iodeosin	....	1	....	....	1*	....	....
Iodine	1–2	....	1	....	1*–1–2	1	....
Tincture	....	....	....	....	2	....	....
Trichloride	....	....	1	....	2	1	....
Iodoform	2	1	....	....	2	....	....
Iron (Metal)	....	....	1	....	2	1–2–3	....
Acetate	1	....	....	....	....	1	....
Albuminate	....	....	....	....	2	....	....
& Ammonium Citrate	2	....	....	....	2	1	....
& Ammonium Oxalate	1–2	....	....	....	1–2	1	....
& Ammonium Sulphate	1–2	....	1	....	1*–1	1	....
Iron by Hydrogen	1	....	1	....	2	1	....
Chloride	1–2	....	1	....	1*–1–2	1	....
Citrate	2	....	....	....	2	1	....
Ferrocyanide	....	....	....	....	1–2	....	....
Filings	1	....	1	....	2	1	....
Glycerophosphate	....	....	....	....	2	....	....
Hypophosphite	2	....	....	....	2	....	....
Iodide	2	....	....	....	2	....	....
Nitrate	1	....	1	....	1*–1	....	....
Oxalate	1–2	....	....	....	2	1	....
Oxide	1–2–3	....	1	....	2	1	....
Peptonate	....	....	....	....	2	....	....
Phosphate	1–2	....	....	....	2	1	....
Pyrophosphate	....	....	....	....	2	1	....
Sulphate	1–2–3	....	1–2	....	1*–1–2	1	....
Sulphide Lumps or Sticks	1	....	1–2–3	....	2	1	....
Wire No. 30 for Standardizing	1	....	1	....	....	1	....
Kaolin	1–2	....	....	....	3	....	....
Lacmoid	....	1	....	....	1*	....	....
Lactose	1–2	1–2	....	....	2	1	....
Lead Metal	1	....	1	....	2	1	....
Free from Ag	1	....	1	....	1	1	....
Acetate	1–2–3	....	1–2–3	....	1–2	1	....
Acetate, Neutral	1	....	1–3	....	1*–1	1	....
Arsenate	1–2	....	....	3	1–2	1	....
Arsenite	....	....	....	....	2	1	....
Acetate Basic Sugar Anal.	1	....	1	....	1	1	....

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co.	General Chemical Co.§	Graselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Lead Borate	1-2	....	....	....	1	1	
Bromide	....	....	....	....	2	1	
Carbonate	1-2	....	1	....	1	1	
Chloride	1-2	....	1	....	1	1	
Chromate	1-2	....	1	....	1	1	
Iodide	1-2	....	....	....	2	1	
Lactate	....	....	....	....	....	1	
Nitrate	1-2-3	....	1	....	1	1	
Oxide, Brown Manganese Free	....	....	....	....	1	1	
Oxide, Brown for Ultimate Anal.	....	....	....	....	1*	1	
Oxide	1-2	....	1	....	1	1	
Oxide, Yellow	2	....	1-2	....	1-2	1	
Peroxide	1-2	....	1-2	....	2	1	
Phosphate	1	....	....	....	2	1	
Refined	....	....	....	....	1	1	
Subacetate, Sol.	1	....	....	....	2	1	
Sulphate	1-2	....	1	....	1	1	
Sulphide	1	....	....	....	....	1	
Tartrate	1	....	....	....	....	1	
Lecithin	....	2	....	....	2	....	
Lithium Acetate	2	....	....	....	2	1	
Benzoate	2	....	....	....	2	1	
Bromide	2	....	....	....	2	1	
Carbonate	1-2	....	1-2	....	2	1	
Chloride	1-2	....	1	....	1	1	
Citrate	2	....	....	....	....	1	
Fluoride	1	....	1-2	....	1	1	
Nitrate	1-2	....	1	....	2	1	
Salicylate	2	....	....	....	2	....	
Sulphate	1	....	....	....	1	1	
Litmus Cubes	1	....	1	....	2	1	
Paper, Blue, Red or Neutral	1	....	1	....	2	1	
Magnesite	1-3	....	2	....	....	1	
Magnesium (Metal)	1	....	1	....	2	1	
Bromide	1-2	....	....	....	1	1	
Carbonate	1-2	....	1	....	1*-1-2	1	
Chloride, Cryst.	1-2-3	....	1	....	1*-1-2	1	
Citrate	1-2	....	....	....	2	1	
Glycerophosphate	2	....	....	....	2	....	
Hypophosphite	2	....	....	....	2	....	
Iodide	....	....	....	....	....	1	
Nitrate	1-2-3	....	1	....	1	1	
Oxide, Sulphur Free	1	....	1	....	1*	1	
Peroxide	2	....	....	....	2	1	
Phosphate	1-2	....	....	....	2	1	
Phosphate, Dibasic	....	....	....	....	2	1	
Phosphate, Tribasic	....	....	....	....	2	1	
Salicylate	2	....	....	....	2	1	
Silicate	1	....	....	....	2	....	
Sulphate	1-2	....	1-2	....	1*-1-2-3	1	
Sulphate, Cryst.	1	....	1-2	....	1-2	1	
Sulphate, Dried Anhyd.	1-2	....	....	....	1	1	
Malachite Green	....	2	....	....	2	....	
Maltose	....	1	....	....	2	....	
Manganese (Metal)	1	....	....	....	2	1	
Acetate	1	....	....	....	2	1	
Bromide	....	....	....	....	....	1	
Carbonate	1-2	....	1	....	1	1	
Chloride	1-2	....	1	....	1-2	1	
Citrate	....	....	....	....	2	....	
Dioxide	....	....	1-2	....	1-2	1	
Glycerophosphate	....	....	....	....	2	....	
Hypophosphite	....	....	....	....	2	....	
Iodide	....	....	....	....	2	1	
Nitrate	1	....	1	....	1	1	
Nitrate, Liquid 50%	....	....	....	....	1	1	
Phosphate	1	....	....	....	2	1	
Sulphate	1-2	....	1	....	1-2	1	
Marble Chips	....	....	2	....	....	1-3	
Menthol	2	1	....	....	2	....	

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co.	General Chemical Co.§	Graselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Mercurous Chloride (Calomel)	2	....	1	....	1-2	1	
Chloride (Electrolytic for Standardization)	1-2	....	....	....	1	1	
Mercury	2-3	....	1-2	....	1*-1-2-3	1	
Acetate	2	....	1	....	1	1	
Ammonium Chloride	....	....	....	....	2	1	
Bichloride	1-2	....	1	....	1*-1-2	1	
Blue Mass	....	....	....	....	2	....	
Blue Ointment	....	....	....	....	2	....	
Bromide	1	....	....	....	1	1	
Cyanide	1-2	....	....	....	1	1	
Iodide	2	....	....	....	1	1	
Nitrate	1-2	....	1	....	1	1	
Oxide Yellow	2	....	1	....	2	1	
Oxide Red	1-2	....	1	....	2	1	
Sulphate	1-2	....	1	....	1	1	
Sulphide Red	1-2	....	1	....	1	1	
White Precipitate	....	....	....	....	2	....	
& Potassium Iodide	....	....	....	....	2	1	
Methylene Blue	2	1-2	....	....	2	....	
Methyl Acetate	....	1	2	....	....	1	
Iodide	1	1	....	....	2	1	
Orange	1	1	1	....	1*	1	
Red	1	1	1	....	1*	1	
Salicylate	1	1-2	....	....	2	1	
Violet	....	1	....	....	2	....	
Microcosmic Salts	1-2	....	1	....	1-2	1	
Monomethyl-Para-Amido-Phenol Sulphate	....	2	....	....	2	....	
Morphine	....	....	....	....	2	....	
Morphine Ethyl	....	....	....	....	2	....	
Naphthalene	1-2	1-2	....	....	2	1	
Naphthol	1-2-3	1-2	1	....	2	1	
Naphthylamine	1	1	....	....	....	1	
Nessler's Solution	....	....	....	....	2	1	
Neutral Red	....	1-3	....	....	....	....	
Nickel Metal, Shot	1	....	1	....	2	1	
Acetate	1-2	....	....	....	1	1	
Ammonium Chloride	....	....	....	....	2	1	
Ammonium Sulphate	1-2	....	1	....	1	1	
Bromide	....	....	....	....	2	1	
Carbonate	1-2-3	....	1	....	1	1	
Chloride	1-2-3	....	1	....	2	1	
Nitrate	1-2	....	1-2	....	1	1	
Oxide	1-2	....	1	....	2	1	
Sulphate	1-2-3	....	1	....	1*-1	1	
Nicotine	....	1-2	....	....	1	....	
Nitroso Betanaphthol	1-2	1	1	....	1	1	
Nitrobenzene	1	1-2	2	....	2	1	
Nitron	....	1	....	....	....	....	
Nitrotoluene	....	1	....	....	....	....	
Oenanthic Ether	....	1	....	....	....	....	
Oil, Cottonseed	1	....	....	....	....	....	
Mineral	....	....	....	....	2	....	
Osmium	....	....	....	....	2	....	
Pancreatin	....	....	....	....	2	....	
Papain	....	....	....	....	2	....	
Paper, Congo	....	....	....	....	....	1	
Filter	....	....	1	....	....	1	Eaton-Dikeman Co.
Litmus	1	....	1	....	2	1	
Phenolphthalein	....	....	....	....	....	1	
Turmeric	....	....	1	....	....	1	
Paraldehyde	2	1-2	....	....	2	....	
Para-Aminophenol	....	1	....	....	....	....	
Para-Dichlorbenzene	....	1-2	....	....	2	....	
Paraffin	....	....	1	....	....	1-3	
Para-Formaldehyde	....	1	....	....	2	....	
Para-Nitrochlorobenzene	....	1-2	....	....	....	....	
Pepsin	....	....	....	....	2	....	
Peptone Witter's	....	....	....	....	2	....	
Petrolatum	1	....	2	....	2	....	
Pharmaceuticals	1-2-3	....	....	....	2	....	

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co.	General Chemical Co.§	Grasselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Phenolphthalein	2	1	1	....	1*	1	
Phenol	1-2	1	1	....	1*-1-2	1	
Phenylhydrazine	1	1	....	....	2	1	
Hydrochloride	1	1	....	....	2	1	
Ph. Indicators	....	1	....	....	....	....	La Motte Chemical Products Co.
Phloroglucinol	....	1	....	....	1*	....	
Phosphoric Anhydride	1	....	1	....	2	1	
Phosphorus	2	....	....	....	2	....	
Oxychloride	1	....	....	....	....	1	
Pentachloride	1	....	1-2-3	....	....	1	
Pentasulphide	1	....	....	....	....	1	
Red Amorphous	1	....	1	....	2	1	
Sticks Yellow	2	....	2	....	2	1	
Trichloride	1	....	1	....	2	1	
Phthalic Anhydride	....	1	....	....	1	1	
Pilocarpine	....	....	....	....	2	....	
Piperine	....	1	....	....	2	....	
Plaster Paris	3	....	2	....	3	....	
Platinum Chloride	1	....	1	....	2	1	
Solutions	....	....	1	....	....	1	
Potassium (Metal)	1	....	1	....	2	1	
Acetate	1-2	....	1	....	1	1	
Acid Phosphate	....	....	....	....	1	1	
Acid Phthalate	....	....	....	....	1*	1	
Arsenate	1-2	....	....	....	1	1	
Arsenite	1-2	....	1	....	1	1	
Bicarbonate	1-2	....	1	....	1*-1-2	1	
Bichromate	1-2-3	....	1-2	....	1*-1	1	
Biniodate	....	....	....	....	2	1	
Binoxalate	1-3	....	1	....	1	1	
Bisulphate, Fused	1-2-3	....	1	....	1*-1	1	
Bisulphate, Cryst.	1-3	....	1	....	1-2	1	
(meta) Bisulphite	1-2	....	1	....	1	1	
Bitartrate, Cryst.	....	....	....	....	1-2	1	
Bitartrate, Po.	1-2	....	1	....	1-2	1	
Bromate	1-2	....	1	....	1*-1	1	
Bromide	1-2	....	1	....	1*-1-2	1	
Carbonate, Cryst.	1	....	1	....	1-2	1	
Carbonate, Po.	2	1	1	....	1*-1-2	1	
Chlorate, Cryst.	1-2	....	1	....	1*-1-2	....	
Chlorate, Po	2	....	....	....	1-2	1	
Chloride	1-2-3	....	1	....	1*-1-2	1	
Chromate	1-2	....	1	....	1*-1	1	
Citrate	1-2	....	1	....	1-2	1	
Cyanide	1-2-3	1	2	....	1-2	1	
Ferricyanide	1-2-3	....	1-2	....	1*-1-2	1	
Ferrocyanide	1-2	....	1-2	....	1*-1-2	1	
Fluoride	1-2-3	....	1	....	1*	1	
Glycerophosphate	1	....	....	....	2	....	
Hydroxide	1-2-3	....	1-2	....	1*-1-2	1	
Hypophosphite	2	....	....	....	2	1	
Iodate	1-2	....	1	....	1*-1	1	
Iodide	1-2	1	1-2	....	1*-1-2	1	
Iodide Neutral	....	....	....	....	2	1	
Metabisulphite	1	....	....	....	1*	1	
(Metal) Balls	....	....	1	....	2	1	
Nitrate	1-2	....	1	....	1*-1	1	
Nitrite, Sticks	2	....	1	....	1-2	1	
Oxalate, Neutral	2	....	1	....	1*-1	1	
Perchlorate	1	....	....	....	2	1	
Permanganate	1-2	....	1-2	....	1*-1-2	1	
Persulphate	1-2	....	....	....	1*-1	1	
Phosphate, Monobasic	1-2	....	1	....	1*-1	1	
Phosphate, Dibasic	1-2	....	1	....	1-2	1	
Phosphate, Tribasic	1-2	....	....	....	1-2	1	
Pyrophosphate	1	....	....	....	2	1	
Silicate	....	....	....	....	2	1	
Sodium Tartrate	1-2	....	....	....	1*-1-2	1	
Sulphate, Cryst.	1-2	....	1-2-3	....	1*-1-2	1	
Sulphate, Po.	2	....	....	....	1-2	1	

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co.	General Chemical Co.§	Grasselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Potassium Sulphide	1	....	2	....	2	1	
Sulphite	1-2	....	....	....	2	1	
Sulphocyanide	1-2-3	....	1	....	1*-1	1	
Tartrate, Cryst.	1-2	....	1	....	1	1	
& Sodium Tartrate, Cryst.	1	....	1	....	1*-1-2	1	
& Sodium Tartrate, Po	2	....	....	....	1-2	1	
Procaine	....	....	....	....	2	....	
Pyridine	1-3	1-3	....	....	2	1	
Pyrogallol	1-2	1	1	....	1*-1-2	1	
Quinine	2	....	....	....	2	....	
Raffinose	....	....	....	....	2	....	
Reagents	1-2-3	....	1	....	1*-1	1	
Blood	1-2-3	....	....	....	1*-1	....	
Diagnostic	1-2-3	....	....	....	1-2	....	
Resorcinol	2	1	1	....	1*-2	1	
Saccharose	2	....	....	....	1*-1-2	1	
Saccharin	1-2	1	....	....	2	1	
Sanguinarine Nitrate	....	....	....	....	2	....	
Santonin	....	....	....	....	2	....	
Saponin	....	....	....	....	2	....	
Sea Sand	....	....	....	....	1	1-3	
Selenium	....	....	1	....	2	....	
Silicon Dioxide	....	....	....	....	....	1	
Silver Acetate	....	....	....	....	2	1	
Bromide	....	....	....	....	2	1	
Chloride	1	....	....	....	2	1	
Nitrate	1-2	1	1	....	1*-1-2	1	
Sulphate	1	....	1	....	1*-1	1	
Soda Lime No. 4 Mesh	1	....	1-2	....	1	1	
Sodium, Metal	1	....	1	....	1*-2	1	
Acetate, Cryst.	1-2-3	....	1-2	....	1*-1-2	1	
Acetate, Anhydr	1-2	....	1	....	1	1	
Aluminum Sulphate	1-2	....	....	3	....	1	
Amalgam	....	....	1	....	....	1	
Ammonium Phosphate	1-2	....	1	....	1*-1	1	
Arsenate	1-2	....	1	....	1	1	
Arsenite	1-2	....	1	....	2	1	
Benzoate	2	1	....	....	2	1	
Bicarbonate	1-2	....	1-2	2	1*-1	1	
Bicarbonate USP	2	....	....	2	2	2	
Bichromate	1-2-3	....	1	3	2	1	
Bismuthate	1-2	....	1	....	1	1	
Bisulphate, Cryst.	1-2-3	....	1	....	1-2	1	
Bisulphate, Fused	1-2-3	....	1	3	1	1	
Bisulphite	1-2	1	1-2-3	3	1	1	
Bitartrate	1-2	....	1	....	1-2	1	
Borate, Cryst. & Po	2	....	1-2	....	1*-1-2	1	
Bromate	1-2	....	....	....	1	1	
Bromide	1-2	....	1	....	1	1	
Calcium Hydrate	1	....	1-2	....	1*-1-2	1	
Carbonate, Dried	....	....	....	....	1-2	1	
Carbonate, Cryst.	1-2-3	....	1-2	3	1*-1-2	1	
Carbonate, Anhydr	1-2-3	....	1-2	3	1*-1	1	
Chlorate	1-2	....	1	....	1-2	1	
Chloride, Cryst. or Gran	1-2	....	1-2	....	1*-1	1	
Chromate	1-2	....	1	....	1	1	
Citrate	1-2	....	1	....	1-2	1	
Cyanide	1-2-3	1	1	3	1*-1	1	
Ethylate	....	....	....	....	....	1	
Fluoride	1-2-3	....	1-2-3	3	1-2	1	
Formate	1-2	....	....	....	1	1	
Hydroxide, from Sodium	....	....	....	3	1*-1	1	
Hydroxide Sticks (so-called By Alcohol)	1-2	....	1-2	....	1*-1	1	
Hydrosulphite	1	....	....	....	....	1	
Hypochlorite	....	....	1	....	....	1	
Hypophosphite	1-2	....	....	....	2	1	
Iodate	1	....	....	....	1	1	
Iodide	1-2	....	1	....	1-2	1	
Metal	....	....	1	....	1*-2	1	
Molybdate	1-3	....	....	....	1	1	

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co.	General Chemical Co.§	Grasselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Sodium, Nitrate, Cryst.	1-2	....	1-2	....	1*-1	1	
Nitrite, Sticks	1-2	....	1	....	1*-1-2	1	
Nitrite, Gran.	2-3	1	2	....	1	1	
Nitroprusside	1	....	1	....	1*-1	1	
Oleate	2	....	....	....	2	1	
Oxalate	1-2-3	....	1	....	1-2	1	
Oxalate Soerensen's fro. standardisation	1	....	....	....	1*	1	
Perchlorate	1-2	....	....	....	1-2	1	
Peroxide	1-2	....	1	....	1*-1	1	
Phosphate, Dibasic	....	....	1-3	2-3	1*-1-2	1	
Phosphate, Monobasic	....	....	1	....	1-2	1	
Phosphate, Tribasic	....	....	1-3	3	1-2	1	
Phosphate	1-2-3	....	....	2-3	1*-1-2	1	
Phosphate, Dibasic Anhyd.	....	....	....	....	1*	1	
Pyrophosphate	1-2-3	....	....	....	1*-1	1	
Potassium Carbonate	1	....	....	....	2	1	
Salicylate	1-2	1	....	....	1-2	1	
Silicate	1	....	2-3	3	3	1-3	
Silicofluoride	1	....	1	3	1	1	
Succinate	1	1	....	....	2	1	
Sulphate, Cryst.	1-2	....	1-2-3	3	1*-1-2	1	
Sulphate, Anhyd.	1-3	....	1	3	1*-1-2	1	
Sulphite	1-2	....	3	3	....	1	
Sulphide	1-2	....	1-2-3	3	1*-1-2	1	
Sulphite, Cryst.	1-2	....	1-2-3	3	1-2	1	
Sulphite, Anhydr.	1	....	1-3	....	1*-1	1	
Tartrate	1-2	....	1	....	1	1	
Thiosulphate, Cryst.	1-2	....	1-2-3	3	1*-1-2-3	1	
Thiosulphate, Anhydr.	....	....	1	....	2	1	
Thiocyanate	1-2-3	....	1	....	1-2	1	
Tungstate	1-2	....	....	....	1*-1	1	
Solutions, Volumetric	....	....	1	....	2	1	
Solvents	....	1	....	....	....	1	
Sparteine Sulphate	....	....	....	....	2	....	
Starch, Arrowroot	1	....	1	....	....	1	
Corn	1	....	....	....	....	1	
Iodized	1	....	....	....	....	1	
Potato	1	....	1	....	....	1	
Soluble	1	....	1	....	....	1	
Wheat	1	....	1	....	....	1	
Strontium Acetate	1	....	....	....	1	1	
Bromide	1-2	....	....	....	2	1	
Carbonate	1-2-3	....	1	....	1	1	
Chloride	1-2	....	1	....	1-2	1	
Chloride, Barium Free	....	....	....	....	1*	1	
Hydroxide	1-3	....	....	....	2	1	
Iodide	....	....	....	....	2	1	
Nitrate	1-2-3	....	1	....	1-2	1	
Sulphate	1-2	....	1	....	2	1	
Strophanthin	....	....	....	....	2	....	
Strychnine	....	....	....	....	2	....	
Sucrose, Cryst.	1	....	....	....	1*-1-2	1	
Sugars, Rare	....	....	....	....	2	....	
Sulphur, Precip.	2	....	2	....	2	1	
Chloride	1	....	2	....	2	1	
Dioxide (Anhyd.)	1	....	1	3	....	1	
Iodide	....	....	....	....	....	1	
Tartar Emetic	2-3	....	....	....	2	1	
Terpin Hydrate	2	1	....	....	2	....	
Terpineol	....	1	....	....	2	....	
Test Papers	....	....	1	....	....	1	
Tetraiodofluorescein	....	1	....	....	2	....	
Theobromine	....	1	....	....	2	....	
Therium Salts	....	....	....	....	....	1	
Thymol	2	1	....	....	2	....	
Blue	....	1	....	....	....	....	
Iodide	2	....	....	....	2	....	
Phthalein	....	1	....	....	....	....	
Tin (Metal), Mossy, Sticks & 20-30 Mesh	1	....	1	....	2	1	
Bichloride	1-3	....	1-3	3	2	1	

Chemical	J. T. Baker Chemical Co.†	Eastman Kodak Co.	General Chemical Co.§	Grasselli Chemical Co.	Merck & Co. Inc.	Sterling Products Company	
Tin Chloride	....	....	1-2	3	1*-1-2	1	
Oxide	....	....	....	3	1-2	1	
Toluene	1-2	1-2	2	....	1-2	1	
Tungsten & Salts	....	....	....	....	....	1	
Uranium Acetate, N. Free	1-2	....	....	....	1*	1	
Acetate	1	....	....	....	1	1	
Nitrate	1-2	....	1	....	1	1	
Nitrate, Fr. Fr. Alkali Salts	1	....	....	....	1*	1	
Salts	....	....	....	....	....	1	
Urea	1-2	1	....	....	2	....	
Vaccines	....	....	....	....	....	....	
Vanillin	....	1	....	....	2	....	
Veratrine & Its Salts	....	....	....	....	2	....	
Volumetric Solutions	....	....	1	....	2	1	
Whiting	....	....	....	....	2	....	
Xylene	1-2	1	2	....	1-2	1	
Zinc Metal	1-2	....	1	....	1*-1-2-3	1	
Metal, As. Free, Mossy-shot-sticks 10-20 mesh	1	....	1	....	1*	1	
Metal, Mossy,—shot sticks po. 10-20	1-2	....	1-2	....	1	1	
Acetate	1-2	....	....	....	1-2	1	
Bromide	1-2	....	....	....	2	1	
Carbonate	1-2	....	1	....	1-2	1	
Chloride, Gran.	1-2-3	....	1	3	1*-1-2	1	
Chloride, Sticks	1-2	....	1	....	1-2	1	
Cyanide	....	....	....	....	....	1	
Iodide	....	....	....	....	2	1	
Nitrate, Cryst.	1-2	....	1	....	1-2	1	
Oxalate	1	....	....	....	2	1	
Oxide, Wet Proc.	1	....	....	....	1*-1-2	1	
Stearate	2	....	....	....	2	1	
Sulphate, Cryst	1-3	....	1	3	1*-1-2	1	
Sulphate, Po.	1	....	....	....	1-2	1	
Sulphide	1	....	....	....	2	1	

EASTMAN KODAK COMPANY

Research Laboratories

ROCHESTER, NEW YORK

EASTMAN ORGANIC CHEMICALS

USES

Eastman Organic Chemicals are used in the laboratories of the leading schools, universities and research institutions throughout the country. Although they were first produced in 1918 as a war measure to supply scientists with research chemicals, they are now widely used as general laboratory reagents. In addition to their valuable use in organic and biochemical research, they are now used as analytical reagents, sensitizers, indicators, stains, solvents and for many other purposes.

GRADES

Many of the chemicals are obtainable in two or three grades. The "Eastman" grade is of the first quality and applies only to chemicals which have been purified to the highest degree. The "Practical" chemicals consist of preparations, which, although not of the highest purity, are suitable for general laboratory work. "Technical" chemicals are more or less crude materials obtained from large scale manufacturers.

NEW CHEMICALS

We are constantly adding to our list new chemicals which are in demand. As these become available, they are listed in the News Editions of "Industrial and Engineering Chemistry." We are always interested in inquiries for chemicals not on our list and will be glad to reply promptly as to the possibility of their manufacture by us.

QUALITY SPECIFICATIONS

Our experience has shown that the terms "C. P." and "Highest Purity" applied to organic chemicals have little meaning. Consequently, all of our Eastman Chemicals are purified to definitely specified melting points and boiling ranges, which give a true representation of the actual purity. In comparing quotations on organic chemicals it is as necessary to compare these specifications as the prices.

HOW TO ORDER

The identification number of each chemical should always be given as this avoids errors and permits prompt shipment. For convenience to laboratory workers all of our chemicals are packed in metric units. No charge is made for containers. Many of the larger laboratory supply houses carry stocks of our chemicals. In order to insure promptness of reply lists of chemicals for quotation should be submitted in duplicate.

"AMERICA'S HANDBOOK OF ORGANIC CHEMICALS"

From time to time we issue a complete catalog, giving prices and purity specifications for all of our chemicals. The latest list, No. 19, published in October, 1928, should be in the hands of every purchaser of organic chemicals. We shall be pleased to mail you an up-to-date copy on request.

J. T. BAKER CHEMICAL COMPANY

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Telephone: Phillipsburg 5400

New York Sales Office:
420 LEXINGTON AVENUE
Telephone: LEXington 10436

Chicago Office and Warehouse: 2213 SO. LA SALLE ST., Telephone: VICtory 9019

COMPREHENSIVE LIST OF REAGENT CHEMICALS

In the alphabetical list of reagent chemicals shown in the foregoing pages, you will find the comprehensive list of items that we manufacture. As it is impossible to include every chemical in this list, however, we suggest that you send for our catalog which shows our entire line.

ANALYSIS ON LABEL

To facilitate the accuracy of laboratory processes we originated the idea of placing the analysis on the label. This practice of specifying impurities was a genuine achievement for it appealed widely to chemists. The idea was adopted by other manufacturers and all reagents, as a rule, now carry the analysis.

STANDARD OF MANUFACTURE

The Baker conception of quality is not surpassed in idea or execution. The Baker Label, with its analysis of contents, is a guarantee of unmistakable purity and strength. And in addition, our reputation for manufacturing to the highest standard is assurance of satisfaction.

SERVICE AND REPRESENTATIVES

We carry large stocks, so unusual requirements, as well as those of ordinary nature, are promptly taken care of. Our representatives in the United States and in many parts of the world also carry complete stocks. Among them are:

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Newark ..... N. J. Laboratory Supply Co.

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Mine and Smelter Supply Co.
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Hawaii
Honolulu ..... Benson, Smith & Co.

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GRADES OF REAGENTS

We have two grades of reagent chemicals to meet the various laboratory requirements. Besides Baker's C. P. Analyzed chemicals, we also have Baker's "Purified with Analysis" chemicals which is a grade designed for elementary laboratory work. This grade, however, is of a standard comparable to many laboratory chemicals sold under the designation "C. P." and bears the analysis on the label in the same way as do "C. P. Baker's Analyzed."

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36,000 chemists are on our mailing list to receive the publication, "The CHEMIST-ANALYST." This magazine contains descriptions of laboratory methods and short cuts written by and for laboratory men. If you are engaged in laboratory analytical work, ask us to place your name on our list so that you will receive "The CHEMIST-ANALYST" regularly.

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Materials and Equipment for the Colorimetric Determination of Hydrogen Ion Concentration.

Standards and solutions for Water Analysis and for examination of Sewage, Effluents, Industrial Wastes, etc.

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Full explanation of the Hydrogen Ion Method of Control, its practical application to a large number of industries and complete description of the equipment are given in our illustrated book "The A B C of Hydrogen Ion Control." Sent to you free on request.

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Whenever the manufacturing process calls for accurate knowledge of the acidity or alkalinity of solutions, this knowledge is now obtained by the determination of the hydrogen ion concentration colorimetrically by La Motte Standards. It is recognized that hydrogen ion concentration—that is, degree of the acidity and alkalinity and not total acidity and alkalinity is the important factor in such determinations. Accurate measurements, which were impossible by the old methods, can now be obtained in a few minutes, even by men who have had no chemical training.

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EASTON, PA.

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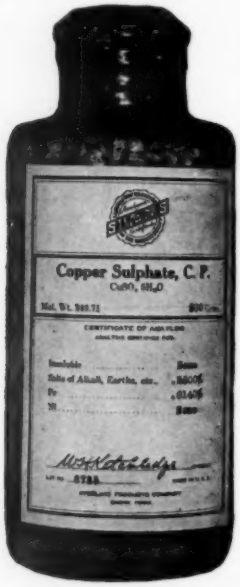

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SEE PAGES 319 TO 333, FOR LIST OF STERLING'S "ANALYSIS-CERTIFIED" REAGENT CHEMICALS

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"C"—Chemicals and Minerals
"F"—Laboratory, Vocational and Library Furniture
"G"—Physics and Chemistry Laboratory Apparatus
"L"—Lantern Slides and Projection Apparatus
"S"—General School Supplies

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Representing among others

WEBER COSTELLO CO.....BLACKBOARDS
STEEL FURNITURE CO.....SCHOOL DESKS
ACME CHAIR CO.....FOLDING CHAIRS
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TELL CITY CHAIR CO.....TABLET ARM AND OFFICE CHAIRS

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CATALOG SENT ON REQUEST.
SERVICE QUALITY AND PRICE

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American Seating Company Seating
Sheldon Laboratory Furniture
Nystrom Maps and Globes
Weber Costello Blackboards
Draper Window Shades
Smith Heaters and Chemical Toilets
Durabilt Steel Lockers
Leavitt Knocked Down Bleachers
Huntington Sanitary Supplies
Universal Playground Equipment

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Peabody Seating Co.....School Furniture
Theodor Kundtz Co.....School Furniture
L. O. Draper Shade Co.....Window shades
Hill-Standard Co.....Playground equipment
A. J. Nystrom & Co.....Maps, globes
Ideal School Supply Co...Kindergarten equipment
Berger Mfg. Co.....Steel lockers and Cabinets
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Kewaunee Mfg. Co.....Laboratory Furniture
Weber Costello Co.....Blackboards
Smith System Heating Co...Heaters and Chemical Toilets
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DISTRIBUTORS FOR

IDEAL SCHOOL SUPPLY CO.
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T. W. VINSON, *Executive Secretary*

Section IX

ARCHITECTS
FOR EDUCATIONAL BUILDINGS

The following directory is restricted to architects who, during the last five years, have designed three or more school or college buildings costing over $50,000 each.

Many of these architects have, of course, handled during this period a much larger amount of work in the educational field than that shown. Space limitations, however, have necessitated the restricting of each architect to three listings, and the buildings mentioned are regarded as typical examples of the architects' recent work.

No attempt has been made to evaluate the skill or professional standing of the architects listed. Boards of Education and persons interested in the construction of new buildings can obtain valuable advice in this matter from the presidents of the local chapters of the American Institute of Architects, or from the national headquarters of that organization, The Octagon, Washington, D. C., or from such sources as the United States Bureau of Education, the respective state departments of education, the Bureau of Education of the National Catholic Welfare Conference, or the Department of Educational Administration of Teachers College, Columbia University, New York.

For convenience in consulting the list, the 48 states are arranged in alphabetical order, and under each state heading the sequence is not by cities, but by architects' names for the entire state in alphabetical order.

ALABAMA

Fredrick Ausfeld, Montgomery
Sidney Lanier High School, Montgomery
Gymnasium Building, Montgomery
Goode Street Grammar School, Montgomery

Denham & Denham, Birmingham
Fairfield High School, Fairfield
Fairfield Junior High School, Fairfield
Ensley-Howard High School, Ensley (affiliated with Howard College, Birmingham)

Hirsch & Jones, Montgomery
Dothan Elementary School, Dothan
Bonifay Elementary School, Bonifay, Fla.
Chipley Elementary School, Chipley, Fla.

Miller & Martin, Architects; **J. A. Lewis**, Engineer, Birmingham
Group of seven buildings for the University of Alabama, Tuscaloosa
Group of four buildings for Birmingham-Southern College, Birmingham
Three school buildings for Board of Education, Birmingham

Bem Price, Birmingham
Tupelo High School, Tupelo, Miss.
Minor High School, Jefferson County
Dormitory, Athens College, Athens

W. A. Rayfield, Birmingham
Unity College, Muskogee, Okla.
Hudson Public School, Birmingham
Guadalupe College Buildings, Seguin, Texas

A. Duncan Simpson, Gadsden
Gadsden High School, Gadsden
Etowah Grammar School, Gadsden
East Gadsden Grammar School, Gadsden

Warren, Knight & Davis, Birmingham
Erskine Ramsay Engineering Building, Alabama Polytechnic Institute, Auburn
Chemistry Building, University of Alabama, Tuscaloosa
New group of buildings, Alabama College, Montevallo

ARIZONA

Fitzhugh & Byron, Phoenix
Phoenix Junior College, Phoenix
Clarkdale High School, Clarkdale
Phoenix Union High School (colored), Phoenix

Lescher & Mahoney, Phoenix
Stadium, Phoenix Union High School, Phoenix
St. Mary's Parochial Grade School, Phoenix
Jerome High School, Jerome

Roy Place, Tucson
University of Arizona Group, Tucson
High School, Tucson
State School for the Deaf and Blind Group, Tucson

V. O. Wallingford, Phoenix
James Russell Lowell School, Phoenix
Emerson Primary School, Phoenix
Flagstaff High School, Flagstaff

ARKANSAS

John P. Almand, Little Rock
Bentonville High School, Bentonville
Morrilton High School, Morrilton
Russellville Junior and Senior High School, Russellville

James Dinwiddie, Fayetteville
Washington Grade School, Springdale, and Westside School, Fayetteville
High School with Annexes, Fayetteville
Junior-Senior High School, Springdale

George R. Mann, Wanger & King, Little Rock
North Little Rock High School, North Little Rock
Hickory Street School, North Little Rock
County School Buildings, Pulaski County

CALIFORNIA

Allison & Allison, Los Angeles
Myrtle Avenue Elementary School, Monrovia
Roosevelt Elementary School, Colton
Auditorium and classroom building, University of California, Los Angeles

Bakewell & Brown, San Francisco
Loeb Marine Laboratory, Stanford University, Pacific Grove
New group of dormitory buildings, Stanford University, Palo Alto
Douglas Everett Grammar School, San Francisco

Richard M. Bates, Jr., Los Angeles
La Ballona Junior High School, Culver City
South Whittier Junior High School, Whittier
Azusa City Schools, Azusa

Edwin Bergstrom, Los Angeles
Auditorium and Administration Building, John C. Freeman High School, Los Angeles
Science and Shop Buildings, same
Boys' and Girls' Gymnasium Buildings, same

Charles H. Biggar, Bakersfield
Kern County Union High School Group
Lincoln School, Bakersfield
Standard School, Oildale

Leon Caryl Brockway, Pasadena
Jefferson Primary School, Pasadena
Jefferson Elementary School, Pasadena
Arroyo Seco School, Pasadena

A. A. Cantin, San Francisco
Martin Junior College, Kentfield
Alhambra High School, Alhambra
Dos Palos High School, Dos Palos

W. D. Coates, Jr., Co.
Hanford Union High School, Hanford
Porterville Union High School, Porterville
Sanger Union High School, Sanger

Norman R. Coulter, San Francisco
Monterey Union High School, Monterey
Central Elementary School, Sausalito
Del Norte County Union High School, Crescent City

Louis N. Crawford, Santa Maria
Orcutt Union School
Toleta Union School
San Luis Obispo School (T. C. Kistner & Co., Associate Architects)

Davis-Pearce Co., Stockton
The College of the Pacific, Stockton
Marysville Union High School, Marysville
Manteca Union High School, Manteca

John J. Donovan, Oakland
St. Mary's College Group, Moraga
Eureka Junior High School, Eureka
Clawson Elementary School, Oakland

Frederick H. Eley, Santa Ana
Julia Lathrop Junior High School, Santa Ana
Roosevelt Grade School, Santa Ana
Gymnasium, High School, Santa Ana

Rudolph Falkenrath, Jr., Los Angeles
Norma Gould School of the Dance, Los Angeles
Wonderland Avenue School, Los Angeles
102nd Street School, Los Angeles

Franklin T. Georgeson, Eureka
Arcata Union High School, Arcata
Fortuna Union High School, Fortuna
Ferndale Grammar School, Ferndale

Frank M. Goodwin, Compton
Beryle Heights Grammar School, Redonda Beach
Compton Union High School Gymnasium, Compton
Watts High School, Watts

J. de Forest Griffin, Los Angeles
Chehalis Junior High School, Chehalis, Wash.
Bellarmine Jesuit College Group, Tacoma, Wash.
St. Mary's Academy, Cowlitz, Wash.

Myron Hunt & H. C. Chambers, Los Angeles
Library, Orr Hall, and Erdman Hall (women's dormitories), Occidental College, Eagle Rock, Los Angeles
Lankershim High School, Los Angeles
Whittier Union High School Group, Whittier

Jeffery & Schaefer, Los Angeles
Franklin High School, Los Angeles
Montebello High School, Montebello
Banning Union High School, Banning

Clarence A. Kelso, Los Angeles
Abraham Lincoln Elementary School, Lynwood
Chas. A. Lindbergh Elementary School, Lynwood
Davis Elementary School, Duarte

T. C. Kistner & Co., Los Angeles (also San Diego)
Excelsior Union High School Group, Norwalk
Theodore Roosevelt Junior High School, San Diego
Brea-Olinda Union High School, Brea

Norman F. Marsh & Co., Los Angeles
Physical Education Building, University of Redlands, Redlands
Junior High School, South Pasadena
Hollywood High School Auditorium, Los Angeles

Mott M. Marston, Los Angeles
Tustin Union High School Buildings, Tustin
May Henning School, Ventura
Selma Avenue School, Los Angeles

Marston, Van Pelt & Maybury, Pasadena
Andrew Jackson Grammar School, Pasadena
Longfellow Grammar School, Pasadena
Central Junior High School, Riverside

Albert C. Martin, Los Angeles
Conaty Memorial High School, Los Angeles
Lomita High School of Los Angeles Group
Polytechnic High School (two buildings), Los Angeles

Mayo, Bissell & Co., Stockton
Auditorium and Conservatory Building, College of the Pacific, Stockton
New group of buildings, Calaveras Union High School, San Andreas

Henry H. Meyers, San Francisco
Washington Union High School, Centerville
Grade School, Alvarado
Grade School, Decoto

Miller & Pflueger, San Francisco
Jefferson Elementary School, San Francisco
Alamo Elementary School, San Francisco
Roosevelt Junior High School, San Francisco

DeWitt Mitcham, San Bernardino
Thomas Jefferson Elementary School, San Bernardino
St. Elmo Elementary School, San Bernardino
San Bernardino Valley Junior College Gymnasium, San Bernardino

Morgan, Walls & Clements, Los Angeles
Rosemead Grammar School, Rosemead
Auditorium Unit, Polytechnic High School, Los Angeles
Theatre Unit, Egan School of Dramatic Art, Los Angeles

Karl W. Muck, County Architect, Los Angeles
Juvenile Hall School (for delinquent minors) Los Angeles
El Retiro School (Girls' Rehabilitation School), San Fernando
Occupational Therapy School (for consumptive children), Olive View

James T. Narbett, Richmond
Roosevelt Junior High School, Richmond
Fairmont Grade School, Richmond
Woodrow Wilson Grade School, Richmond

A. S. Nibecker, Jr., South Pasadena
Richard Henry Dana Junior High School, San Pedro
Victory Boulevard Elementary School, Lankershim
Dorris Place Elementary School, Los Angeles

E. L. Norberg & John E. Norberg, San Francisco
San Mateo High School Group, San Mateo
Grand Avenue Grammar School, South San Francisco
High School Gymnasium, Burlingame

Paul C. Pape, Los Angeles
Physical Training Building, Hollywood High School, Los Angeles
97th Street Elementary School (Original building), Los Angeles
97th Street Elementary School (Second building), Los Angeles

J. A. Porporato, San Francisco
Fairfax School, Fairfax, Marin County
Salesian House of Studies Group, Richmond, Contra Costa County

W. H. Ratcliff, Jr., Berkeley
New group of buildings, Mills College, Oakland (also, general scheme for future development)
New group of buildings, Pacific School of Religion (also, general scheme for future development)
Hillside School, Berkeley

Alfred W. Rea & Chas. E. Garstang, Los Angeles
New group of buildings, El Segundo High School, El Segundo
Administration and Auditorium Building, Compton Union High School, Compton
Chemawa Junior High School, Riverside

Reed & Corlett, Architects and Engineers, Oakland
Chabat Grammar School, Oakland
Dixon Grammar School, Dixon
Oakland High School, Oakland

M. P. Benfro, San Bernardino
San Bernardino Valley Junior College Gymnasium, San Bernardino
Thomas Jefferson Grammar School, San Bernardino
San Bernardino Junior High School Gymnasium, San Bernardino

A. F. Rosenheim, Los Angeles
Remodeling of Hollenbeck Heights Junior High School, Los Angeles
Girls' Gymnasium and Open-Air Lunching Pavilion, same
42nd Street School, Los Angeles

Allen Ruoff, Los Angeles
Wilshire Branch Library, Los Angeles
Vernon Avenue School, Los Angeles
Sierra Vista School, Los Angeles

Howard Schroder, Oakland
Lowell Junior High School, Oakland
Morris B. Cox Elementary School, Oakland
Prescott Domestic Science Unit, Oakland

George C. Sellon & Co., Sacramento
Yuba City Union High School, Yuba City
Colusa Union High School, Colusa
Loomis Union Grammar School, Loomis

Shields, Fisher & Lake, Fresno
Roosevelt High School, Fresno
Lincoln Grammar School, Taft
Benjamin Franklin School, Fresno

Horace G. Simpson, San Francisco
Sacramento High School and Junior College, Sacramento (Edgar A. Mathews, Associate Architect)
Grass Valley High School, Grass Valley (William Mooser, Associate Architect)
Church School (First Congregational Church), Berkeley

Soule, Murphy & Hastings, Santa Barbara
Roosevelt Elementary School, Santa Barbara
Harding Elementary School, Santa Barbara
Frederick Forrest Peabody Elementary School, Santa Barbara

Fay R. Spangler, Santa Ana
Laguna Grammar School, Laguna Beach
Magnolia Grammar School, Orange County
Yorba Linda Grammar School, Orange County

Swartz & Ryland, Fresno
Grammar School, Tulare
Heaton Elementary School, Fresno
Gymnasium, High School, Coalinga

Ralph D. Taylor, Susanville, Lassen County
Roosevelt Elementary School, Susanville, Lassen County
High School Group, Greenville, Plumas County
High School Group, Portola, Plumas County

Edward Cray Taylor & Ellis Wing Taylor, Architects and Engineers, Los Angeles
Cabrillo Avenue Elementary School, San Pedro
Glassel Park Elementary School, Los Angeles
Hooper Avenue Elementary School, Los Angeles

Walker & Eisen, Los Angeles
Thomas A. Edison Junior High School, Los Angeles
Humphreys Avenue School, Los Angeles
South Park School, Los Angeles

W. H. Weeks, San Francisco
Santa Barbara High School, Santa Barbara
Santa Rosa High School, Santa Rosa
Woodrow Wilson Junior High School, San Jose

G. Stanley Wilson, Riverside
Riverside Junior College, Riverside
Corona High School, Corona
Palm School, Riverside

Carleton Monroe Winslow, Los Angeles
Fullerton Union High School Group, Fullerton
Eagle Rock High School, Los Angeles
Thacher School Library, Ojai

Henry J. Withey, Los Angeles
Fries Avenue Elementary School, Wilmington
Malabar Street Elementary School, Los Angeles
Van Nuys Elementary School, Van Nuys

A. C. Zimmerman & A. M. Edelman, Los Angeles
Horace Mann Junior High School, Los Angeles
West Athens School, Los Angeles
52nd Street School, Los Angeles

COLORADO

William N. Bowman Co., Denver
Gymnasium, State Teachers College, Greeley
Cole Junior High School, Denver
High School, Fort Collins

T. H. Buell & Co., Denver
Asbury Elementary School, Denver
Mountair School, Jefferson County
Fruitdale School, Jefferson County

Walter DeMordaunt, Pueblo
Park Hill Junior High School, Pueblo
Pleasant View High School, Pueblo
Hot Springs County High School, Thermopolis, Wyo.

William E. & Arthur A. Fisher, Denver
South High School, Denver
Morey Junior High School, Denver
Barnes Commercial School, Denver

Eugene G. Groves, Denver
Library, Colorado Agricultural College, Fort Collins
High School, Canon City
Fairview Grade School, Denver

Henry James Manning, Denver
Residence Hall, Regis College, Denver
Fairmont Grade School, Denver
Washington Park Grade School, Denver

Marean & Norton, Denver
Globeville Grade School, Denver
Phi Rho Sigma Fraternity House, University of Colorado Medical School, Denver
Washington Park Grade School, Denver

I. H. & W. M. Rapp Co., Trinidad
Willson Hall—Science building for New Mexico Military Institute, Rosewell, N. Mex.
Cahoon Armory for New Mexico Military Institute, Roswell, N. Mex.
St. Mary's Parochial School, Walsenburg

E. Floyd Redding, Denver
Opportunity School (Vocatfonal High School), Denver
High School, Nogales, Ariz.
High School, Casper, Wyo.

Walter H. Simon, Denver
Lakewood Grade School, Denver
Englewood Grade Schools (two), Englewood
Kappa Sigma Fraternity House, University of Denver, Denver

Geo. H. Williamson, Denver
East Senior High School, Denver
Wm. H. Smiley Junior High School, Denver
Henry M. Teller Grade School, Denver

CONNECTICUT

Leonard Asheim, Bridgeport
Junior High School, Bridgeport
Roosevelt School (City Normal), Bridgeport
Whittier School, Bridgeport

Fred'k H. Beckwith, Bridgeport
Warren Harding High School, Bridgeport (Associated with Caldwall, Walker & Beckwith)
Nichols School, Stratford
Wilcoxson Avenue School, Stratford

Walter P. Crabtree & Son., Hartford
Lincoln Elementary School, New Britain
Federal Hill Elementary School, Bristol
Vocational High School, New Britain

A. Graham Creighton, New London
Hand Academy, Madison
Charles B. Jennings Grammar School, New London
Rutland High School, Rutland, Vt.

R. W. Foote, New Haven
West Haven High School, West Haven
Branford High School, Branford
Silsbey Science Hall, Talladega, Ala.

George H. Gray, New Haven
Berea College, Berea, Ky.
South Campus: Rogers Hall (Girls' Dormitory); Woods-Penniman Building (Women's Union)
North Campus: Emery Building (Domestic Science); Science Hall; Seabury Gymnasium for Men
East Campus: Agricultural Building

William E. Hunt, Torrington
Central Grade School, Winsted
Greenwood School, Winsted
Wetmore School, Torrington

Wm. D. Johnson, Hartford
Seymour High School, Seymour
Francis Stillman Grammar School, Wethersfield
Holcomb Street Grammar School, Hartford

William T. Marchant, Hartford
High School, West Hartford
Junior High School, West Hartford
Grade School, East Hartford

Mylchreest & Reynolds, Hartford
Washington Street School Addition, Hartford
Our Lady of Sorrows Grammar School, Hartford
Dormitory, Westminster School, Simsbury

Delbert K. Perry & Earle K. Bishop, New Britain
Group of buildings, Connecticut Agricultural College, Storrs
Junior High School, Newington
Washington Elementary School, New Britain

Wm. Thomas Towner, Middletown
Farmington High School, Farmington
Calvin Coolidge Junior High School, Shrewsbury, Mass.
Samuel Huntington School, Norwich

Max J. Unkelbach, New Britain
Nathan Hale Junior High School Annex, New Britain
Vocational High School (State Trade School), New Britain
Israel Putnam School, New Britain

Whiton & McMahon, Hartford
Alfred E. Burr School, Hartford
Richard J. Kinsella School, Hartford
James H. Naylor School, Hartford

DISTRICT OF COLUMBIA

Milburn-Heister & Co., Washington
Junior High School, Durham, N. C.
School of the Blessed Sacrament, Washington
Fayetteville High School, Fayetteville, N. C.

Rossel Edw. Mitchell, Washington
Methodist Protestant College, High Point, N. C.
High School, Bethesda, Md.
Grade School, Falls Church, Va.

Upman & Adams, Washington
Washington-Lee High School, Ballston, Arlington County, Va.
George Mason High School, Del Ray, Arlington County, Va.
Lucretia Mott Grade School, Washington

FLORIDA

Franklin O. Adams, Tampa
Plant High School, Tampa
Henry B. Mitchell Graded School, Tampa
Thonotosassa Graded School, Thonotosassa

T. M. Bryan, Architect and Acoustical Engineer, Sarasota
Dormitory No. 1, Florida Industrial School for Girls, Ocala
Golf Street Primary School, Sarasota
Nokomis Junior High School, Nokomis

Carpenter & Bent, De Land
Senior and Junior High School, New Smyrna
Seabreeze Elementary School, Daytona Beach
Volusia Avenue Grade School, Daytona Beach

W. M. Christen, Melbourne
High School, Melbourne
Primary School, Melbourne
Elementary School, Melbourne

Frank Dunham, Tampa
N. P. Broward School, Tampa
Oak Park School, Tampa
Federated and Musicale Auditorium, Tampa

M. Leo Elliott, Inc., Tampa
Sarasota Senior High School, Sarasota
Dade City Grammar School, Dade City
Orange Grove Elementary School, Tampa

C. Frank Galliher, Tampa
Ballast Point Junior High School, Ballast Point
West Shore Junior High School, Port Tampa
Desota Park Grammar School, Tampa

August Geiger, Miami
Shenandoah Junior High School, Miami
Robert E. Lee Auditorium, Miami
Montmare School, Miami Beach

Mellen C. Greeley, Jacksonville
John Gorrie and Edmund Kirby Smith Junior High School Annex buildings, Jacksonville
Madison High School, Madison
Greenville High School, Greenville

Harry M. Griffin, Daytona Beach
Junior-Senior High School, Daytona Beach
Junior-Senior High School, Leesburg
Junior-Senior High School, Titusville

Bert D. Keck, Stuart
Stuart High and Grade School, Stuart
Indiantown Grade School, Indiantown
High and Junior High School, East Grand Forks, Minn.

Francis J. Kennard & Son, Tampa
Hillsborough High School, Tampa
Memorial Junior High School, Tampa
West Tampa Junior High School, Tampa

Kiehnel & Elliott, Miami
Miami Senior High School, Miami
Group of buildings, Coral Gables Elementary School, Coral Gables
Greenfield Elementary School, Pittsburgh, Pa.

Maurice E. Kressly, Orlando
Greensburg Junior-Senior High School, Greensburg, Pa.
Lincoln High School, Ridgeway, Pa.
St. James' Roman Catholic Parish School, Orlando

H. G. Little Associates, Wauchula
Zolfo Springs High School Group, Zolfo Springs
Fort Meade High School Group, Fort Meade
Wauchula High School, Wauchula

Mark & Sheftall, Jacksonville
Robert E. Lee and Andrew Jackson High Schools, Jacksonville
High and Grade School, Crescent City, Putnam County
Elementary School, Palatka, Putnam County

H. Hastings Mundy, Miami
Ada Merritt Junior High School, Miami
Robert E. Lee Junior High School, Miami
Dade County Agricultural Senior High School, Miami

Howard M. Reynolds, Orlando
Group of three buildings, Orlando Senior High School, Orlando
Group of two buildings, Orlando Junior High School No. 1, Orlando
Group of four buildings, Winter Park Junior-Senior High School, Winter Park

E. L. Robertson & L. R. Patterson, Miami
Auditorium and Cafeteria, Riverside School, Miami
Auditorium and Cafeteria, Highland Park School, Miami
Miami Shores School, Miami

Henry L. Taylor, St. Petersburg
South Side Junior High School, St Petersburg
Lakeview Avenue Grade School, St. Petersburg
Grade School for Colored Children, St. Petersburg

Rudolph Weaver, Gainesville
Administration Building, Agricultural and Mechanical College, Tallahassee
Chemistry-Pharmacy Building, University of Florida, Gainesville
Horticultural Building, University of Florida, Gainesville

Henry P. Whitworth, Lakeland
Polk City Grammar School, Polk City
Webster Avenue School, Lakeland
John F. Cox Grammar School, Lakeland

Frank A. Winn, Jr., Tampa
Benjamin Franklin Junior High School, Tampa
Wimauma Elementary-High School, Wimauma
John T. Kenley Elementary School, Uceta

GEORGIA

Edward F. Billie, Atlanta
High School, Anniston, Ala.
Auditorium and Gymnasium Wing, Alabama Military Institute, Anniston, Ala.
High School, Live Oak, Fla.

Harold Bush-Brown & J. H. Gailey, Atlanta
Julius Brown Memorial Hall (dormitory), Georgia School of Technology, Atlanta
N. E. Harris Hall (dormitory), same
Dining Hall, same

Daniell & Beutell, Atlanta
William A. Russell High School, Fulton County, Atlanta
Marietta High School, Marietta
English Avenue School, Atlanta

Dunwody & Oliphant, Macon
Bruce Grammar School, Macon
Law Building, Mercer University, Macon
New group of buildings, Wesleyan College, Macon (Walker & Weeks, Associate Architects)

Edwards & Sayward, Atlanta
Training School, Winthrop College, Rock Hill, S. C.
Columbia Theological Seminary, Atlanta
Girls Senior High School, Atlanta

Greer & Biggers, Valdosta
Midville Consolidated School, Midville
Jesup High School, Jesup
Lakeland High School, Lakeland

Hentz, Adler & Shutze, Atlanta
Fulton County High School, Atlanta
School of Commerce and Journalism Building, University of Georgia, Athens
Science Building, Spelman College, Atlanta

Chas. H. Hopson, Atlanta
Clark University, Atlanta
Gammon Theological Seminary, Atlanta
Joel Chandler Harris Grammar School, Atlanta

Willis Irvin, Augusta
Additions and alterations, Girls High School, Augusta
Allendale Centralized School, Allendale, S. C.
William Robinson School, Augusta

Ivey & Crook, Atlanta
Chemistry building, Emory University, Atlanta
Valdosta Junior College for Men, Valdosta
Druid Hills District School (High and Primary), Decatur

Levy & Clarke, Savannah
Bryan County High School, Pembroke
Annex, Waters Avenue School, Savannah
East Side Baldwin Kindergarten, Savannah

T. P. Lockwood, Columbus
Central High School, Phenix City, Ala.
Vocational Building, Industrial High School, Columbus
Group of three buildings, Fitzgerald

Morgan, Dillon & Lewis, Atlanta
Administration Building, Oglethorpe University, Atlanta
Founders Tower Group, same
Lupton and Lowry Halls, same

G. Lloyd Preacher & Co., Inc., Atlanta
Tubman High School for Girls, Augusta
Lanier High School for Boys, Macon
Evans High School, Spartanburg, S. C.

Scroggs & Ewing, Augusta
Academy of Richmond County and Junior College, Augusta
Monte Sano Grammar School, Augusta

Matthews H. Tardy, Macon (Formerly of L. P. Smithey & Tardy, Roanoke, Va.)
Roanoke Senior High School, Roanoke, Va.
Roanoke Junior High School, Roanoke, Va.
Consolidated School, Rockymount, Va.

Thole & Legeman, Atlanta
Assumption Parochial School, Eville
Emma Roach Elementary School, Eville
Howard Roosa Elementary School, Eville

Wallin & Comer, Savannah
Memorial High School and Auditorium, Savannah
Science Building, Georgia State Agriculture School
Cuyler Street School, Savannah

HAWAII

C. W. Dickey, Honolulu
Roosevelt High School, Oakland, Calif.
University High School, Oakland, Calif.
New group of buildings, Kamehameha School, Honolulu (Associate Architect)

L. E. Davis, Architect; **Ralph A. Fishbourne,** Associate Architect, Honolulu
Large group of buildings, New McKinley High School project, Honolulu

IDAHO

Wayland & Fennell, Boise
Administration and Library Building, Pocatello
Administration and Library Building, Albion State Normal School, Albion
High School, Payette

ILLINOIS

Ralph E. Abell Co., Chicago
Palatine Township High School, Palatine
McHenry Community High School, McHenry
Arlington Heights Township High School, Arlington Heights

Aldrich & Aldrich, Galesburg
Alexis Community High School, Alexis
Cooke Grade School, Galesburg
Fairview High School, Fairview

Ashby, Ashby & Schulze, Chicago
J. Sterling Morton High School, Cicero
Leyden Community High School, Franklin Park
John Mills School, Elmwood Park

Bradley & Bradley, Rockford
John W. Henney Grade School, Freeport
Community High School, South Beloit, Wis.
Community High School, Stillman Valley

Herbert A. Brand, Chicago
St. Paul's Evangelical Lutheran School, Indianapolis, Ind.
Dormitory, Evangelical Theological Seminary, Naperville
Gymnasium, Concordia Teachers College, River Forest

Brooks, Bramhall & Dague, Decatur
Roosevelt Junior High School, Decatur
Southeast Junior High School, Decatur
Washington Grade School, Decatur

Olof Z. Cervin, Rock Island
Seminary Group, Augustana College and Theological Seminary, Rock Island
Edison Junior High and Grade School, Rock Island
Audubon Grade School, Rock Island

Childs & Smith, Chicago
Haven Intermediate School, Evanston
Jackson High School, Jackson, Mich.
Horace Mann Elementary School, Oak Park

John D. Chubb, Chicago
Central Senior High School, Power Plant, and Elementary Schools, Kenosha, Wis.
Southeastern Junior High School, Battle Creek, Mich.
Maine Township High School, Cook County

Edwin H. Clark, Inc., Chicago
Chicago Latin School, Chicago
Group of buildings, North Shore Country Day School, Winnetka
Group of buildings, Glenwood Manual Training School, Glenwood

S. A. Clausen, Decatur
Mt. Zion Community High School, Mt. Zion
Niantic Community High School, Niantic
Mt. Auburn Community High School, Mt. Auburn

Coolidge & Hodgdon, Chicago
Group of seven buildings, University of Chicago, Chicago
Group of three buildings, St. Olaf College, Northfield, Minn.
Glenbard High School, Glen Ellyn

S. Lester Daly, Metropolis
Herrin Grade School, Herrin
Christopher Community High School, Christopher
Carterville Community High School, Carterville

Doerr & Doerr, Chicago
Whittier Grade School, Blue Island
Loretto Academy, Chicago
Evergreen Park Grade School, Evergreen Park

Hamilton B. Dox, Peoria
City High School, Bushnell
Community High School, Manito
St. Mark's Parochial School, Peoria

N. Max Dunning, Architect; **Van Gunten & Van Gunten**, Associate Architects, Chicago
Roosevelt School, Broadview
Garfield School, Maywood
Lincoln School, Maywood

A. B. Frankel, East St. Louis
Hawthorne Elementary School, East St. Louis
Woodrow Wilson Elementary School, East St. Louis
Junior High School, Litchfield

Gill & Jackson, Murphysboro (also St. Louis, Mo.)
Du Quoin Township High School, Du Quoin
Rebuilding—Murphysboro Township High School, Murphysboro
Logan Junior High School, Murphysboro

Hamilton, Fellows & Wilkinson, Chicago
Evanston Township High School, Evanston
Capital University, Columbus, Ohio
Skokie School, Winnetka

Helmle & Helmle, Springfield
Feitshans School, Springfield
Pana Township High School, Pana
St. Mary's Academy, Salt Lake City, Utah

Hewitt, Emerson & Gregg, Peoria
Three Elementary Schools, Aurora
Grade School and High School, Carlinville
Elementary School, Jacksonville

Holmes & Flinn, Chicago
James Russell Lowell School, Oak Park
Carleton College Group, Northfield, Minn.
Stadium, Carleton College, Northfield, Minn.

J. W. Kennedy, East St. Louis
Collinsville Township High School, Collinsville
Dupo Community High School, Dupo
Freeberg Community High School, Freeberg

Lewis & Dougherty, Chicago
Danville High School, Danville
West Chicago High School, West Chicago
J. H. Freeman Grade School, Aurora

Liese & Ludwick, Danville
Mayo Junior High School, Paris
Community High School, St. Joseph
Community High School, Tuscola

Jos. C. Llewellyn Co., Chicago
Lyons Township High School, La Grange
Elementary School (Platoon System), Aurora, Ill.
York Community High School, Elmhurst

Benj. Franklin Olson, Chicago
Rearrangement of campus layout, Elmhurst College, Elmhurst
Group of twelve new buildings and Entrance Gateway, same
Gymnasium and Natatorium Building, same

Oman & Lilienthal, Chicago
School and Parish House, German Evangelical Lutheran Congregation, Chicago
Sigma Delta Tau Sorority House, University of Illinois, Urbana
Sigma Alpha Mu Fraternity House, University of Illinois, Champaign

Edgar A. Payne, Carthage
Consolidated School, Winnebago
Community High School, Durand
Grade and High School, Paw Paw

Perkins, Chatten & Hammond, Chicago
Senior High School, Port Smith, Ark.
Three Elementary Schools, Park Ridge
North Elementary School, River Forest

Peterson & Johnson, Rockford
Theodore Roosevelt Junior High School, Rockford
Abraham Lincoln Junior High School, Rockford
Marengo Community High School, Marengo

L. Pfeiffenberger's Sons, Alton
Clara Barton School, Alton
Marquette High School, Alton
Lincoln School, East Alton

Pond, Pond, Martin & Lloyd, Chicago
Roger Sullivan Junior High School, Chicago
Clinical Hospital Group, University of Illinois, Chicago
Michigan Union Building, Ann Arbor, Mich.

James B. Rezny & Adrian Rezny, Chicago
St. Marie of Celle Elementary School, Berwyn
Our Lady of the Mount Elementary School, Cicero
St. Michael Archangel Elementary School, Chicago

Herbert Hugh Riddle, Chicago
Dormitory, Chicago Theological Seminary, Chicago
Hilton Chapel, same
Library and Taylor Hall, same

Monroe R. Sandel & Co., Chicago
St. Michael's Parochial School, Chicago
St. Hyacinth's Parochial School, Chicago
St. Casimir's Parochial School, Chicago

Schmidt, Garden & Erikson, Chicago
Laboratory and Library, Medical School, University of Illinois, Chicago
College of Pharmacy, University of Illinois, Chicago
Nurses Training School, Michael Reese Hospital, Chicago

N. S. Spencer & Son, Chicago
North and South Intermediate High Schools, Saginaw, Mich.
Junior High School, Whiting, Ind.
Junior High School, Independence, Kan.

Leo Strelka, Chicago
St. Hilary's Elementary School, Chicago
St. Eulalia's Elementary School, Maywood
St. Bronislava's Elementary School, Chicago

Leonard F. W. Stuebe, Danvillé
City High School, Kankakee
Tilton Grade School, Danville
Grade and Junior High School, Savanna

Zook & McCaughey, Chicago
Maine Township High School, Park Ridge
Mt. Prospect School, Mt. Prospect
St. Paul's Lutheran Evangelical School, Mt. Prospect

INDIANA

Austin & Shambleau, South Bend
James Whitcomb Riley Junior High School, South Bend
The Oliver Junior High and Elementary School, South Bend
James Madison Junior High and Elementary School, South Bend

Addison C. Berry & Co., Hammond
Hammond High School, Hammond
Lincoln Grade School, Hammond
Thornton Fractional Township High School, Calumet City, Ill.

Harry E. Boyle & Co., Evansville
High School, Paoli
Junior High School, Harrisburg, Ill.
High School, Hardinsburg, Ky.

Bradley & Babcock, Architect and Engineer, Fort Wayne
North Webster High and Grade School, North Webster
La Paz High School, La Paz
Bourbon Consolidated School, Bourbon

Everett I. Brown, Fort Wayne
Montpelier Junior High School, Montpelier
P. A. Allen High School, Bluffton
Syracuse High School, Syracuse

Charles H. Byfield, Indianapolis
Grade School No. 76, Indianapolis
Grade School No. 85, Indianapolis
Centre Township Grade School No. 3, Indianapolis

Robert Frost Daggett, Indianapolis
Lucy Rowland Hall (Girls' Dormitory), De Pauw University, Greencastle
School of Commerce Building, Indiana University, Bloomington
Butler University Group, Indianapolis (Thomas Hibben, Associate Architect)

Foltz, Osler & Thompson, Indianapolis
Newcastle High Scohol, Newcastle
Theodore Potter Fresh Air School, Indianapolis
New group of buildings, Rose Polytechnic Institute, Terre Haute

J. W. Gaddis, Vincennes
High School, Oaktown
High School, Sandborn
High School Addition, Edwardsport

George & Zimmerman, Indianapolis
Vocational Building, State Normal School, Terre Haute
Valparaiso University Group, Valparaiso
Dormitories, Athens College for Young Women, Athens, Ala.

Henkel & Hanson, Connersville
Jefferson Township, Boone County, School, Dover
Madison High School, Madison
Little Flower School, Indianapolis

Norman H. Hill, Indianapolis
Junior High School, Columbus
Gymnasium, High School, Columbus
Union Township Consolidated School, Johnson County

O. L. Hill, Bedford
Ellettsville High School, Ellettsville
Needmore High School, Needmore
Fayetteville High School, Fayetteville

Johnson, Miller, Miller & Yeager, Terre Haute
Woodrow Wilson Junior High School, Terre Haute
Girls' Dormitory, Indiana State Normal School, Terre Haute
Gymnasium Building, Indiana State Normal School, Terre Haute

Kervick & Fagan, South Bend
Holy Cross Seminary, Notre Dame
Morrissey Hall, University of Notre Dame, Notre Dame
Lyons Hall, same

McGuire & Shook, Indianapolis
School at Indiana Masonic Home, Franklin
School No. 62, Indianapolis
School, Danville

Karl D. Norris, East Chicago
Roosevelt Junior High School, East Chicago
Lincoln Grade School, Indiana Harbor
La Grange Grade School, La Grange

Wilson B. Parker, Indianapolis
High School, Liberty
Aiken Hall Industrial School, Olive Hill, Ky.
Consolidated School, Kitchel

Wm. Gregory Rammel, Logansport
James Whitcomb Riley Junior High School Group, Logansport
Washington Township Grade and High School, Logansport
Argos High School, Argos

Frank P. Riedel, Lafayette
Highland Grade School, Lafayette
Longlois Grade School, Lafayette
Lincoln Grade School, Lafayette

R. L. Simons, Elkhart
Dormitory, Hanover College, Hanover
Addition to the Goshen Hospital Training School, Goshen
Albion High School, Albion

Geo. J. Stoner & Co., Terre Haute
Glenn High School, East Glenn
North Terre Haute High School, North Terre Haute
Concannon High School, West Terre Haute

Sutton & Routt, Vincennes
High School, Lawrenceville
LaSalle School, Vincennes
Vincennes Gymnasium and Coliseum, Vincennes

Charles L. Troutman, Evansville
Carpenter Grade School, Evansville
Benjamin Bosse High School, Evansville
Tell City High School, Tell City

Wainwright, Vaughn & Co., Hammond
Technical High School, Hammond
Lincoln Elementary School, Chicago Heights
Auditorium-Gymnasium, High School, Grovertown

Werking & Son, Richmond
High School, Hagerstown
High School, Hollansburg, Ohio
High School, Milroy

Joe H. Wildermuth & Co., Gary
Lew Wallace Primary School, Gary
Public Schools Memorial Auditorium, Gary
Tolleston Library, Gary

IOWA

Charles Altfillisch, Decorah
C. K. Preus Gymnasium, Luther College, Decorah
Theta Xi Fraternity House, Iowa City
Gymnasium, High School, Stanton

Beuttler & Arnold, Sioux City
East Senior High School, Sioux City
Girls' Dormitory, Morningside College, Sioux City
High School, Hawarden

Clausen, Kruse & Klein, Davenport
Hayes Elementary School, Davenport
Garfield Elementary School, Davenport
St. Paul's Parochial School, Davenport

Mortimer B. Cleveland, Waterloo
Hawthorne School, Waterloo
Gymnasium, Upper Iowa University, Fayette
Gymnasium, Fletcher College, Oskaloosa

E. O. Damon, Jr., Fort Dodge
St. Mary's School and Convent, Stern Lake
St. Cecilia's School, Algena
Barnum Consolidated School, Barnum

Dougher, Rich & Woodburn, Des Moines
Jefferson Grade School, Muscatine
Senior High School, Marshalltown
Carson Memorial High School, Marengo

Arthur H. Ebeling, Davenport
Maquoketa, Iowa, High School, Maquoketa
Davis Hall, St. Ambrose College, Davenport
St. Joseph's School, Fort Madison

Frank W. Griffith, Fort Dodge
Wahkonsa Grade School, Fort Dodge
Duncombe Grade School, Fort Dodge
Butler Grade School, Fort Dodge

Keffer, Jones & Thomas, Des Moines
Clarinda High School, Clarinda
Mexico High School, Mexico, Mo.
Mediapolis Grade and High School, Mediapolis

Proudfoot, Rawson & Souers, Des Moines
New Medical Group, State University of Iowa, Iowa City
Theodore Roosevelt High School, Des Moines
College buildings, Iowa State College, Ames

Harry E. Reimer, Marshalltown
Garwin High School, Garwin
High School, State Center
High School, Newburg

George A. Spooner, Council Bluffs
Gymnasium, Abraham Lincoln High School, Council Bluffs
Underwood Consolidated School, Underwood
James B. Rue School, Council Bluffs

Thorwald Thorson, Forest City
Lake Mills High School, Lake Mills
Akron High School, Akron
Milford Township Consolidated School, Ames

J. C. Wood Co., Clinton
Grade School, Clinton
High and Grade School, DeWitt
High and Grade School, Preston

KANSAS

W. E. Glover, Topeka, Kans.
Rural High School, Eskridge
High and Grade Schools, Burlingame
High School, Valley Falls

W. E. Hulse & Co., Hutchinson
Junior College, Hutchinson
High School, Minot, N. Dak.
Junior High School, Brookfield, Mo.

Mann & Co., Hutchinson
Senior High School, Dodge City
High School, Bushton
Grade School, Bushton

Routledge & Hertz, Hutchinson
Consolidated School, Winona
Community High School, Leoti
Rural High School, Sylvia

Ralph E. Scamell, Topeka
Benton Hall (Girls' Dormitory), Washburn College, Topeka
Boys' Dormitory, Central College, McPherson
High School, Tonganoxie

Schmidt, Boucher & Overend, Wichita
Administration Building, St. John's College, Winfield
Science Hall, Bethel College, Newton
Group of three buildings, Senior High School, Wichita

Chas. W. Shaver, Salina
High School, Brookville
Bartlett Grade School, Salina
High School, Kanopolis

Smith & English, Hutchinson
Rural High School, Argonia
Rural High School, Oxford
Grade School, La Crosse

Glen H. Thomas, Wichita
Parochial Grade and High School, Andale
Alcott Elementary School, Wichita
New Wichita High School, Wichita

S. S. Voigt, Wichita
High School, Medicine Lodge
Grade School, Caldwell
High School, LeRoy

Thos. W. Williamson & Co., Topeka
High School, Parsons
Science Hall, Baker University, Baldwin
Field House, Washburn College, Topeka

KENTUCKY

H. A. Churchill & John T. Gillig, Lexington
Gymnasium, Kentucky Wesleyan College, Winchester
Dormitory for Girls, Asbury College, Wilmore
Boys' and Girls' Dormitories, Lees Collegiate Institute, Jackson

J. Meyrick Colley, Louisville
Western High School for Girls, Louisville
Highland Junior High School, Louisville
Southern Junior High School, Louisville

Brinton B. Davis, Louisville
Home Economics Building, School Library and School Dormitory; Western Kentucky State Teachers College, Bowling Green
Stadium and Gymnasium, same
High School, Bardstown

O. W. Holmes, Louisville
Mt. Tabor Grade School, New Albany Township, Floyd County, Ind.
Ohio Falls Grade School, Clarksville, Ind.
Oregon Township Grade School, Marysville, Ind.

Albert F. Klein, Ashland
Wm. C. Condit Grade School, Ashland
Jno. F. Hager Grade School, Ashland
Booker T. Washington Grade School, Ashland

Nevin, Wischmeyer & Morgan, Louisville
High School, Harrodsburg
Louisville Collegiate School, Louisville
Augusta Tilghman High School, Paducah

Leo L. Oberwarth & Son, Frankfort
High School and Auditorium, Frankfort
Auditorium and School Building, Institute for Backward Children, Frankfort
Consolidated School, Bagdad

G. Tandy Smith, Jr., Paducah
Group of four buildings, Murray State Teachers College, Murray
Andrew Jackson Grade School, Paducah
Butler High School, Princeton

LOUISIANA

William R. Burk, New Orleans
Harahan Grammar School, Harahan
Hope Haven Agricultural and Mecahnical School, Marrero
DeLaSalle Normal School, Lafayette

E. A. Christy, New Orleans
Henry W. Allen Elementary School, New Orleans
Lafayette Elementary School, New Orleans
Samuel J. Peters Boys High School of Commerce, New Orleans

Herman J. Duncan, Alexandria
Winnfield High School, Winnfield
Churchpoint High School, Churchpoint
Eunice High School, Eunice

Favrot & Livaudais, Ltd., New Orleans
Southwest Louisiana Industrial Institute, Lafayette
Louisiana State Normal College, Natchitoches
Bolton High School, Alexandria

Edward F. Neild, Shreveport
Two High Schools and six Grade Schools, Shreveport
Two High Schools and Grade School, Haynesville
Junior High School, Baton Rouge

William T. Nolan, New Orleans
Baton Rouge Senior High School, Baton Rouge
Lafayette Senior High School, Lafayette
St. Joseph's Church Group, Baton Rouge: Boys' High School, teachers' residence, Gymnasium and Auditorium

Theodore L. Perrier, New Orleans
Eighth Ward School, Jefferson Parish
St. Catherine of Sienna Parochial School, Metairie Ridge
Crossman Annex, New Orleans

MAINE

Bunker & Savage, Augusta
Garrett Schenck Junior High School, East Millinocket
Guilford High School, Guilford
Elsworth High School, Elsworth

Harry S. Coombs, Lewiston
Geo. W. Stearns High School, Millinocket
Lake Street Grade School, Auburn
Martel School, Lewiston

Crowell & Lancaster, Bangor
Arts and Science Building, University of Maine, Orono
Dairy Laboratory, same
Mary S. Snow School, Bangor

MARYLAND

E. G. Blanke, Baltimore
Our Lady Mt. Carmel Roman Catholic Elementary School, Stemmers Run, Baltimore County
St. Rita's Roman Catholic School, Dundalk
St. John's Roman Catholic School, Baltimore

Buckler & Fenhagen, Baltimore
Baltimore City College, Baltimore
Charles Carroll of Carrollton Elementary School, Baltimore
Pimlico Elementary School, Baltimore

A. A. Hileman, Frederick
Maryland Park High School, Prince George's County
Maryland State School for the Deaf, Frederick
High School, Friendsville, Garrett County

A. J. Klinkhart, Hagerstown
Hagerstown High School, Hagerstown
Fairview Avenue Grade School, Waynesboro, Pa.
Hedgesville High School, Hedgesville, W. Va.

Mottu & White, Baltimore
Public School No. 69, Baltimore
Donaldson School, Ilchester, Howard County
Friends School, Baltimore

Smith & May, Baltimore
Gwynns Falls Park High School, Baltimore
Entire Group, Maryland State Normal School, Salisbury
Thirty-one school buildings (total number), Baltimore County

MASSACHUSETTS

Adden & Parker, Boston
Beverly High School, Beverly
Reading Junior High School, Reading
Manter Hall School, Cambridge (Chas. H. Way, Associate Architect)

James E. Allen, Lawrence
Lawrence High School, Lawrence
Francis Leahey Elementary School, Lawrence
George W. Brown Elementary School, Newburyport

Andrews, Jones, Biscoe & Whitmore, Boston
Alumnæ Building, Women's College, Brown University, Providence, R. I.
Alpha Delta Phi Fraternity House, Amherst College, Amherst
Stratton Hall (girls' dormitory), Tufts College, Medford

W. Cornell Appleton & Frank A. Stearns, Boston
Sanford Riley Hall (dormitory), Worcester Polytechnic Institute, Worcester
Memorial Chapel, Middlesex School, Concord
Vocational School and Memorial Auditorium, Southbridge

Ashton, Huntress & Alter, Lawrence
James F. Leonard Elementary School, Lawrence
Central Junior High School, Methuen
West Junior High School, Watertown

Elmer Smith Bailey, Boston
Layout of Wm. E. Nickerson Recreation Field: Stadium, Field Houses, Foot Ball Dormitory, Boat House, etc., Boston University, Boston
School program for Sanford, Me.: Edison and Lincoln Schools and addition to the High School
School program for Manchester, N. H.: Practical Arts High School, West Side High School, and Franklin Grade School

J. Williams Beal, Sons, Boston
Whitman High School, Whitman
Rockland Junior-Senior High School, Rockland
Hanover Junior-Senior High School, Hanover

Bigelow, Kent, Willard & Co., Inc., Boston
Engineering Building, Rhode Island State College, Kingston, R. I.
Library and Auditorium, same
Armory and Gymnasium, same

William H. Brainerd Associates, Boston
Seldon L. Brown School, Wellesley
Six-grade High School, Peterborough, N. H.
Junior High School, Winthrop

Coolidge, Shepley, Bulfinch & Abbott, Boston
Medical School, Vanderbilt University, Nashville, Tenn.
Medical School and Hospital, Western Reserve University, Cleveland, Ohio
Fogg Art Museum, Harvard University, Cambridge

Frank Irving Cooper Corp., Boston
Thomas Snell Weaver High School, Hartford, Conn.
Arlington Junior High School, East Arlington
Morgan Gardner Bulkeley High School, Hartford, Conn.

Edward M. Corbett, Fall River
Technical High School, Fall River
Warren High School, Warren, R. I.
Jerome Dwelly Elementary School, Fall River

John F. Cullen, Boston
School program for City of Fall River, 1927-1930
Frank V. Thompson Junior High School, Boston
Turner's Fall Junior High School, Town of Montague

Derby & Robinson, Boston
Hingham High School, Hingham
George Washington Elementary School, Winchester
Bedford Junior High School, Bedford

Ralph Harrington Doane, Boston
Armitage Grade School, West Cliftondale
Lincoln Avenue Elementary School, Cliftondale
Sharon High School, Sharon

William W. Drummey, Inc., Boston
Wm. McKinley School, Revere
High School, Narragansett, R. I.
Beethoven School (First Standard School), Boston

M. A. Dyer Co., Boston
Municipal Group, Webster: Town Office Building, Senior High School, Junior High Scohol, and Auditorium (one building)
Leominster Junior High School, Leominster
Milton F. Roberts Junior High School, Medford

E. C. & G. C. Gardner, Springfield
Dormitory and Campus Group, International Y. M. C. A. College, Springfield
Technical High School, Springfield
Junior High School, Stafford Springs, Conn.

Edward T. P. Graham & F. Stillman Fish, Boston (also Cleveland, Ohio)
St. Timothy's School, Garfield Heights, Ohio
Our Lady of Pease School, Cleveland, Ohio
Cathedral Latin School, Cleveland, Ohio

Malcolm B. Harding, Westfield
Bay Path Institute, Springfield
High School, Belchertown
Consolidated Grade Schools, Southwick

Haven & Hoyt, Boston
Newton Central High School, Newton
New England Conservatory of Music, Boston
Salem Hospital Training School Home for Nurses, Salem

Haynes & Mason, Fitchburg
John E. Fitch High School, Groton, Conn.
Peaticket Grade School, Falmouth
Groton High School, Groton

Henry & Richmond, Boston
Samuel Phillips Recitation Hall and Morse Laboratory of Chemistry, Physics and Biology, Phillips Academy, Andover
Bridgewater State Normal Group, Bridgewater
Hamilton School, Newton

Hutchins & French, Boston
Henry Whittemore Grade School, Waltham
Group of buildings, Tilton School, Tilton, N. H.
High School, Kennebunk, Me.

Thomas M. James Co., Boston
Deering High School, Portland, Me.
Nashua High School, Nashua, N. H.
Berlin High and Junior High Schools, Berlin, N. H.

Kilham, Hopkins & Greeley, Boston
Alexander Hamilton Junior High School No. 2, Elizabeth, N. J.
James Russell Lowell Grade School, Watertown
George S. Baldwin Grade School and Library, Brookline

J. D. Leland & Co., Boston
Junior High School, Concord, N. H.
Junior High School, Worcester
Group of Grade Schools, Hudson

Morris W. Maloney, Springfield
Elias Brookings School, Springfield
Samuel Bowles School, Springfield
Robert O. Morris School, Springfield

George F. Marlowe, Boston
Lyon Hall, Babson Institute, Wellesley
Bryant Hall, same
Richard Knight Auditorium, same

McLaughlin & Burr, Boston
Hyde Park High School for Boys and Girls, Boston
Senior High School, Port Washington, Long Island, N. Y.
Coolidge Junior High School, Natick

Maurice P. Meade, Boston
High School, St. Mary of the Assumption Parish, Brookline
Elementary School, St. Bernard's Parish, West Newton
Girls Elementary School, St. Clement's Parish, Medford

Mulhall & Holmes Co., Boston
Ralph Waldo Emerson School, Boston
Charles Logue Elementary School, Boston
Milford Elementary School, Milford

Perry, Shaw & Hepburn, Boston
Roxbury Latin School, West Roxbury
New Group for Radcliffe College, Cambridge
Dexter School, Brookline

James H. Ritchie & Associates, Boston
Massachusetts Agricultural College Group, Amherst
High School, Everett
High School, Westboro

Jasper Rustigian, Worcester
Nelson Place School, Worcester
Bloomingdale Road School No. 2, Worcester
Middlesex Avenue School, Worcester

Sanborn & Weed, Lynn
Home-Making School for Girls, Essex County Agricultural School, Hathorne
Cobbett Elementary School and Administration Building (for School Department), Lynn
Tracy Elementary School, Lynn

Matthew Sullivan, Boston
Refectory Building, St. John's Preparatory School, Danvers
St. Thomas' High School, Jamaica Plain, Boston
Our Lady of Grace School, Everett

Edward I. Wilson, Boston
Second unit, Revere Senior-Junior High School, Revere
James A. Garfield Junior High School, Revere
Elementary School, Washington-Allston District, Boston

MICHIGAN

Frank P. Allen & Son, Grand Rapids
Grade and High School, Comstock Park
Grade School, Wyoming Park
Second Ward Grade School, Belding

Billingham & Cobb, Kalamazoo
Dowagiac High and Grade School, Dowagiac
Central High School, South Haven
Harding Grade School, Kalamazoo

Colton & Knecht, Grand Rapids
Gymnasium, St. Andrew's Cathedral Parish High School, Grand Rapids
St. Thomas' School and Chapel, Grand Rapids
St. Isidore's School, Grand Rapids

Cowles & Mutscheller, Saginaw
Central Junior High School, Saginaw
Kinney School, Mt. Pleasant
Daniel Axford Grade School and Auditorium, Oxford

Donaldson & Meier, Detroit
Sacred Heart Seminary Group, Roman Catholic Diocese of Detroit
Elizabeth Cleveland Intermediate School (for Board of Education), Detroit
Thomas M. Cooley High School, same

A. H. Ellwood & Son, Kalamazoo
Covert Centralized School, Covert
Beardsley School, Elkhart, Ind.
Lawrence High School, Lawrence

R. V. Gay, St. Johns
Rogers City High School, Rogers City
Carpenter Street Grade School, Midland
Wenzel Street Grade School, Sturgis

Aaron H. Gould & Son, Detroit
New group of buildings, Wayne County Training School, Northville
High School, Flat Rock
Juvenile Detention School, Detroit

George J. Haas, Detroit
Grosse Pointe High School, Grosse Pointe
Lakeview High School, Ste. Claire Shores
Hamtramck High School, Hamtramck

Warren Holmes-Powers Co., Lansing
National Kindergarten and Elementary College, Evansville, Ill.
Two Elementary Schools, New Britain, Conn.
New Britain High School, New Britain, Conn.

Derrick Hubert, Menominee
Niagara Junior-Senior High and Grade School, Niagara, Wis.
National Mine High and Grade School, National Mine
Watersmeet High and Grade School, Watersmeet

Albert Kahn, Inc., Detroit
Museums Building, University of Michigan, Ann Arbor
Medical Building, same
Angell Hall, same

LeRoy & Newlander, Kalamazoo
Central High School, Kalamazoo
Slocum Truax High School, Trenton
Grade and High School, Watervliet

Frederick D. Madison, Royal Oak
1927 Royal Oak High School and All-Grade School, Royal Oak
Adams Junior High School, Birmingham
Big Beaver School, Big Beaver

Malcomson & Higginbotham, Detroit
Roosevelt Teachers College Group, Detroit
University of Detroit Group, Detroit
Administration Building, Central State Teachers College, Mt. Pleasant

George D. Mason & Co., Detroit
Ulysses S. Grant School, Detroit
Dearborn High School, Dearborn
Charles A. Lindbergh School, Dearborn

McGrath & Dohmen, Detroit
William Ruthruff School, Detroit
John A. Logan School, Detroit
Annie Lathrup School, Birmingham

Harry L. Mead, Grand Rapids
St. Adalbert's Grade School, Grand Rapids
St. Philip's Grade School, Battle Creek
Jefferson Grade School, Ionia

F. E. Parmelee, Iron Mountain
L'Anse High School, L'Anse
Iron Mountain Junior High School, Iron Mountain
Kingsford High School, Kingsford

Lewis J. Sarvis, Battle Creek
Lakeview Consolidated School, Battle Creek
Fremont School, Battle Creek
Southwestern Junior High School, Battle Creek

Smith, Hinchman & Grylls, Detroit
Roosevelt High School, State Normal College, Ypsilanti
Mackenzie High School, Detroit
Robert Trombly Elementary School, Grosse Pointe

Taylor & Tanner, Detroit
Garfield School, Adrian
Lincoln School, Adrian
McKinley School, Adrian

H. H. Turner & V. E. Thebaud, Grand Rapids
Burton Junior High and Elementary School, Grand Rapids
Nelson Elementary and Crippled Children's School, Muskegon
Monroe Junior and Senior High School, Monroe

VanLeyen, Schilling & Keough, Detroit
Fordson High School, Fordson
Birmingham High School, Birmingham
River Rouge High School, River Rouge

Verner, Wilhelm & Molby, Detroit
Orion Combined High and Grade School, Orion
LaFayette Grade School, Lincoln Park
Brighton High School, Brighton

B. C. Wetzel & Co., Detroit
Roosevelt High School, Wyandotte
Andrew Jackson Junior High School, Detroit
Woodruff Grade School, Wyandotte

Albert Wood, Detroit
James Gardner Grade School, Detroit
Davy Street Grade School, Detroit
Beech Street Grade School, Dearborn

MINNESOTA

Croft & Boerner, Minneapolis
Washington Park High School, Racine, Wis.
Consolidated School, Renville
Junior-Senior High School, Ironwood, Mich.

W. R. Dennis, Fergus Falls
Addition to Fergus Falls High School, Fergus Falls
High and Grade School, Oakes, N. Dak.
St. Mary's Parochial School, Breckenridge

Le Roy Gaarder, Albert Lea
Consolidated Grade and High Schools, Freeborn
Consolidated Grade and High Schools, Alden
New Grade School Additions, Albert Lea

F. H. Hafey, Minneapolis
John Marshall High School (for Board of Education), Minneapolis
Washburn Junior High School, same
Maria Sanford Junior High School, same

William M. Ingemann, St. Paul
Macalester College Group, St. Paul (Associate Architect)
Dormitory, Gustavus Adolphus College, St. Peter
Dormitory, University of Minnesota, Minneapolis

C. H. Johnston, St. Paul
Main Building, State Teachers College, Mankato
Main Building, State Teachers College, Winona
City High School, Faribault

Lang, Raugland & Lewis, St. Paul
New group of buildings, Luther Theological Seminary, St. Paul
Slayton High School, Slayton
Grade School for Common School District No. 21, Golden Valley, Hennepin County

Long & Thorshov, Inc., Minneapolis
Concordia College Group, St. Paul: New Campus Layout, New Administration Building, and Dormitory
Northwestern Bible School, Minneapolis

Geo. Pass & Son, & P. T. Rockey, Mankato
Franklin Grade and Junior High School, Mankato
Plainview Complete School, Plainview
St. Peter High School, St. Peter

Albert G. Plagens, New Ulm
St. Anne's Parochial School, Wabasso
Boys' Dormitory, Dr. Martin Luther College, New Ulm
Community Building and High School Gymnasium, Glencoe

C. H. Smith, Duluth
Washburn Grade School, Duluth
Junior High School, Gilbert
Memorial High School, Ely

J. C. Taylor, Hibbing
Brooklyn Grade School, Hibbing
Parochial Junior High School, Hibbing
Cherry High School, Cherry

Toltz, King & Day, Inc., St. Paul
Junior-Senior High School Group, South St. Paul
Dr. Martin Luther College Group, New Ulm
High School, New Prague

MISSISSIPPI

Harry North Austin, Jackson
Administration Building, Millsaps College, Jackson
Men's Dormitory, same
Library, same

Emmett J. Hull, Jackson
High School, Brookhaven
Chamberlain-Hunt Academy Group, Port Gibson
Gulfport Junior High School, St. Petersburg, Fla.

Wilfred S. Lockyer, Gulfport
New group of buildings, Harrison-Stone-Jackson Agricultural High School and Junior College, Perkinson, Miss.: Auditorium, Science Department, Boys' Dormitory, Girls' Dormitory, Gymnasium, Power-house, New Dining Room and Modern Kitchen

Shaw & Woleben, Gulfport
Central Elementary School, Gulfport
Pascagoula High School, Pascagoula
Long Beach School, Long Beach

Vinson B. Smith, Jr., Gulfport
Three buildings, Mississippi State Teachers College, Hattiesburg
Two buildings, Industrial Training School, Columbus

J. M. Spain, Jackson
Administration Building, Blue Mountain College, Blue Mountain
Boys' Dormitory, Mississippi College, Clinton
Administration Building, Hinds County Junior College, Raymond

MISSOURI

Ludwig Abt, Moberly
Grade School and Auditorium Building, Slater
Grade School and Auditorium Building, Fayette
Grade and High School, Atlanta

Bonsack & Pearce, Inc., St. Louis
Ozark Wesleyan College, Carthage
Hardin College Group, Mexico
High School, Bonne Terre

Walter Boschen, St. Joseph
Neeley School, St. Joseph
Hosea School, St. Joseph
Gymnasium, Northwest Missouri State Teachers College, Maryville

Ernest O. Brestrom, Kansas City
Rock Creek Rural School, Independence
Raytown High School, Raytown
Educational Building, Presbyterian Church, Fort Scott, Kans.

Eckel & Aldrich, St. Joseph
Whittier School, St. Joseph
Two buildings, Missouri State School, Marshall
Group of buildings, Palmer College, Albany

Harry C. Eckland & Co., Kansas City
Iowa Wesleyan College Group, Mt. Pleasant, Iowa
Bethany College Group, Lindsborg, Kans.
High School, Muscatine

Ben C. Elliott, Mexico
Mexico Junior and Senior High School, Mexico
Bellflower High School, Bellflower
St. Brendan's School, Mexico

Felt, Dunham & Kriehn, Kansas City
Junior High School, Emporia, Kans.
Columbia Elementary School, Joplin
Junior High School, Beatrice, Nebr.

Ferrand & Fitch, St. Louis
Flynn Park Grade School, University City
Three buildings, Drury College, Springfield
Gymnasium, Iberia Academy, Iberia

Frederick C. Gunn, Kansas City
Training School for Nurses, General Hospital, Kansas City
Training School and Clinic No. 2 (colored), General Hospital, Kansas City
Headquarters Building, Church of the Nazarene, Kansas City

Hoener, Baum & Froese, St. Louis
High School, Owensville
Church School, Cape Girardeau
High School, Jennings

Wm. B. Ittner, Inc., St. Louis
Horace Mann Complete School, Gary, Ind.
Longview Complete School, Longview, Wash.
Jefferson Elementary School, Battle Creek, Mich.

Jamieson & Spearl, St. Louis
Biology, Art and Women's Building, Washington University, St. Louis
Law School, University of Missouri, Columbia
Agricultural and Engineering Buildings, University of Arkansas, Fayetteville, Ark.

La Beaume & Klein, St. Louis
John Burroughs Country Day School, St. Louis County
Washington University School of Dentistry, St. Louis
Irwin Hall Dormitory, Lindenwood College, St. Charles

Madorie & Bihr, Kansas City
Redemptorist High School, Kansas City
St. Michael's Parochial School, Kansas City
St. Joseph's Parochial School, Kansas City

C. F. McClean, Cameron
Grade School, Cameron
Science Hall, Missouri Wesleyan College, Cameron
Girls' Dormitory, same

R. M. Milligan, St. Louis
Theodore Roosevelt High School, St. Louis
William Beaumont High School, St. Louis
Public Schools' Stadium, St. Louis

Owen, Sayler & Payson, Kansas City
Senior High School, Jefferson City
William Chrissman Senior High School, Independence
Senior High School, Marshall

H. D. Pampel, Kansas City
Raytown High School, Raytown
Dodson Grade and High Schools, Dodson
Brookfield High and Grade School, Brookfield

L. Baylor Pendleton, St. Louis
Hall of Science, Mayfield College, Lutesville
Girls' Dormitory, same
Baptist Educational Building, Columbia

Geo. M. Siemens (Successor to Root & Siemens), Kansas City
Rodman Hall (Classroom building), St. Marys College, St. Marys, Kans.
Campus Plan and College Group, same
Gymnasium and Chapel Building, Kidder Institute, Kidder

Chas. A. Smith, Kansas City
Westport Junior High School, Kansas City
Administration and Chapel Building, William Jewell College, Liberty
Horace Mann Teachers Training School, Pittsburg, Kans.

Henry C. Smith, Kansas City
Graceland College Group, Lamoni, Iowa
Kappa Sigma Fraternity House, Lawrence, Kans
Alpha Chi Omega Sorority House, same

Study & Farrar, St. Louis
Teachers Training School, Southeast Missouri State Teachers College, Cape Girardeau
Price District School, Clayton
Sappington Grade School, Sappington

MONTANA

Bird & van Teylingen, Great Falls
Great Falls High School, Great Falls
Conrad High School, Conrad
Roosevelt Grade School, Great Falls

R. C. Hugenin, Missoula
State University Group, Missoula
School of Mines Group, Butte
Girls Vocational School Group, Helena

Shanley & Baker, Great Falls
Gymnasium and Biology Buildings, Montana State College, Bozeman
Anaconda Junior High School, Anaconda
Junior and Senior High School, Glasgow

Fred P. Willson, Bozeman
Boys Central High School, Butte
Gymnasium, State Normal College, Dillon
Woman's Building, Montana State College, Bozeman

NEBRASKA

Arthur D. Baker, Grand Island
Refectory Building, Lutheran Teachers College, Seward
Senior High School, Grand Island
Holbrook Combination High and Grade School, Holbrook

N. R. Brigham, Omaha
Pershing Grade and Junior High School, East Omaha
Underwood Grade and Junior High School, Omaha
Monroe Grade School, Omaha

Leo A. Daley, Omaha
New group of buildings, St. Columban's Preparatory Seminary, near Silver Creek, N. Y.
Sacred Heart Academy, Greeley
New group of buildings, Nebraska School for the Deaf, Omaha

Davis & Wilson, Lincoln
Field House and Stadium, University of Nebraska, Lincoln
Kearney Junior High School, Kearney
Everett Junior High School, Lincoln

E. L. Goldsmith & Co., Scottsbluff
Wheatland Grade School, Wheatland, Wyo.
Minatare High School, Minatare
Orleans High School, Orleans

J. P. Helleberg, Kearney
State Training School, Kearney
Lexington High School, Lexington
Overton High and Grade School, Overton

John Latenser & Sons, Omaha
New group of buildings, Creighton University, Omaha
South High School, Omaha
Shelby Consolidated School, Shelby

Chas. W. Steinbaugh, Omaha
Washington Grade School, Omaha
High School, Manning, Iowa
Walnut Hill Grade School, Omaha

Jas. C. Stitt, Norfolk
High School, Norfolk
Training School, State Normal College, Chadron
Gymnasium, same

NEVADA

F. J. DeLongchamps, Reno
Women's Dormitory, University of Nevada, Reno
Educational Building, same
Sparks Junior High School, Sparks

NEW JERSEY

Charles F. Ackerman, Newark
Public School, Essex Fells
Blessed Sacrament School, Elizabeth
St. Elizabeth's School, Linden

Rolf William Bauhan, Princeton
Hun School Group, Princeton
Solebury School Group, New Hope, Pa.
Princeton Preparatory School Group, Princeton

Cornelius V. R. Bogert, Hackensack
Fisher Avenue School, Bogota
Bogota High School, Bogota
State Street School, Hackensack

H. B. Brady, Inc., Elizabeth
Thomas Jefferson Senior High School, Elizabeth
Linden Junior High School, Linden
Theodore Roosevelt School, Cranford

J. Frederick Cook, Newark
School for Crippled Children, Newark
St. John's College High School, Brooklyn, N. Y.
Addition to East Side High School, Newark

Henry Barrett Crosby, Paterson
Grammar School No. 6, Paterson
Grammar School No. 13, Clifton
Grammar School No. 15, Clifton

Vincent J. Eck, Red Bank
Red Bank Catholic High School, Red Bank
St. Nicholas' High School, Egg Harbor City
Star of the Sea Academy (High School), Long Branch

Edwards & Green, Inc., Camden
Gloucester City High School (for Board of Education), Gloucester City
J. Heulings Coles School (for Board of Education), Delaware Township, Camden County
Erlton School, same

Fanning & Shaw, Paterson
Eastside Senior High School, Paterson
Elementary School No. 8, Paterson
Monroe Street Elementary and Junior High School, Ridgewood

Greisen & Tuzik, Perth Amboy
Middlesex County Vocational School No. 2, Perth Amboy
Public School No. 11, Perth Amboy
Clara Barton School, Raritan Township

Guilbert & Betelle, Newark
Columbia High School, South Orange and Maplewood
State Normal School, New Britain, Conn.
Washington Irving High School, Tarrytown, N. Y.

Hacker & Hacker, Fort Lee
Teaneck High School, Teaneck
Dumont High School, Dumont
William Cullen Bryant School, Teaneck

Hill & Gollner, Trenton
Public School, Williamstown
Witherspoon Street School, Princeton
Grade School, Aura

John F. Kelly, Passaic
Passaic Memorial School, Passaic
Public School No. 12, Passaic
Public School No. 1, Passaic

Lackey & Hettel, Camden
Hammonton High School, Hammonton
Delair School, Pensauken
Camden County Vocational School, Pensauken Township

Lee & Hewitt, Paterson (also New York City)
Clifton High School, Clifton
School No. 15, Paterson
Davison Avenue School, Lynbrook, N. Y.

Lucht & Anderson, Cliffside Park
Presbyterian Church School, Leonia
Trinity Evangelical Lutheran Church School, Hudson Heights
Swedish Evangelical Mission Church School, West New York

Wm. Mayer, Jr., West New York
Memorial High School, West New York
Public School No. 1, West New York
Public School No. 5, Cliffside Park

Arnold H. Moses, Camden
Pensauken Junior High and Grade School, Pensauken Township
Audubon High School, Audubon
Merchantville High School, Merchantville

Ernest Sibley & Lawrence C. Licht, Palisade
High School, Princeton
High School, Orange
School for District No. 1 and Mr. Owen D. Young, Van Hornesville, N. Y.

Simpson & Rolston, Inc., Newark
Buckley School (private), Greenvale, N. Y.
Buckley School (private), Rumson
High School, Mechanicville, N. Y.

Wm. W. Slack & Son, Trenton
Lincoln Elementary and Intermediate School, Trenton
Junior High School, Oxford Furnace
Greenwood Junior High School, Trenton

A. L. Vegliante, Garfield
Midland School No. 1, Midland Township
Roosevelt School No. 7, Garfield
Roosevelt School No. 7, Lyndhurst

Fred Wesley Wentworth, Paterson
School No. 13, Paterson
Wayne School, Wayne Township
Monroe High School, Monroe, N. Y.

NEW MEXICO

Gaastra, Gladding & Johnson, Albuquerque (also Santa Fe)
Eugene Field Grade School, Albuquerque
Gormley Grade School, Santa Fe
University of New Mexico Group, Albuquerque: Biological Building, Gymnasium, Lecture Hall and Dormitory

NEW YORK

Carl C. Ade, Rochester
Lyons High School, Lyons
Charles Perkins School, Newark
Waterloo High School, Waterloo

Allen & Collens, New York City
Union Theological Seminary Group, New York City
Hartford Theological Seminary Group, Hartford, Conn.
Library, Teachers College, New York City

Bagg E. Newkirk, Utica
Sage Athletic Building, Hamilton College, Clinton
Biology-Geology Laboratories, same
Theta Chi Fraternity House, Colgate College, Hamilton

William J. Beardsley, Poughkeepsie
Governor George Clinton School No. 8, Poughkeepsie
Glen Cove School, Glen Cove
S. F. B. Morse School No. 5, Poughkeepsie

Edward J. Berg, Utica
Our Lady of Lourdes Parochial School, Utica
Parochial School for Church of The Annunciation, Ilion
St. Mary's Parochial School, Oneonta

Wesley Sherwood Bessell, New York City
Mount Vernon Seminary, Washington, D. C.
Group of Schools, Great Neck
Public School, Port Washington

Gerard W. Betz, Kingston
Grade and High School, Walden
Grade School, Glasco
Grade School, Kingston

Frank H. Bissell, New York City
St. Gabriel's School, New Rochelle
Roger Ludlow Junior High School, Norwalk, Conn.
Rye Neck High School, Mamaroneck

Bley & Lyman, Buffalo
Canisus College Group, Buffalo
Lackawanna High School, Lackawanna
Harding School, Kenmore

R. L. Bowen, Schenectady
Euclid Elementary School, Schenectady
Oneida Intermediate School, Schenectady
Mt. Pleasant High School, Schenectady

Clarence W. Brazer, New York City
Glen-Nor High School, Glenolden, Pa.
Leonardo High School, Leonardo, N. J.
Prospect Park School, Delaware County, Pa.

Charles A. Carpenter, Rochester. (Successor to Foote & Carpenter)
Phelps Union and Classical School, Phelps
Departmental Church School, Christ Episcopal Church, Poughkeepsie
Departmental Church School, First Methodist Episcopal Church, Lockport

George Cary, Buffalo
Buffalo Historical Building, Buffalo
Medical and Chemistry Departments, University of Buffalo, Buffalo
Dental College, same

G. Howard Chamberlin, Yonkers
Chas. E. Gorton High School, Yonkers
Roosevelt High School, Yonkers
Nathaniel Hawthorne Junior High School, Yonkers

Walter B. Chambers, New York City
Bingham and McClellan Halls (dormitories), Yale University, New Haven, Conn.
Lawrence Hall (lecture) and Stillman Hall (dormitory), Colgate University, Hamilton
Sykes Memorial Manual Training and High School, Rockville, Conn.

Carl W. Clark, Cortland
Baldwinsville High School, Baldwinsville
Massena Grade and High School, Massena
Homer Academy, Homer

Coffin & Coffin, New York City
Saratoga Springs High School, Saratoga Springs
Group of buildings, El Instituto Ingles, Santiago, Chile
Two Elementary Schools, Greenwich, Conn.

Conable, Smith & Rowley, New York City
Administration Building, Lecture Halls and Dormitory, Wagner College, Staten Island
Cortland High School, Cortland
North Side School, East Williston

Conrad & Cummings, Binghamton
Benjamin Franklin School, Binghamton
Alexander Hamilton School, Binghamton
Westover School, Johnson City

Crow, Lewis & Wick, New York City
Sage Engineering Building, New York University, New York City
School of Aeronautics, same
Library Building, College of the City of New York, New York City

Howard F. Daly, Amsterdam
East Main Street Grade School, Amsterdam
Junior High School, Amsterdam
Fifth Ward Grade School, Amsterdam

R. H. Dana, Jr., New York City
Group of eleven buildings, Loomis Institute, Windsor, Conn.
Group of five buildings, Gunnery School, Washington, Conn.
St. Margaret's School, Waterbury, Conn.

Delano & Aldrich, New York City
Recitation Building, Lawrenceville School, Lawrenceville, N. J.
Sterling Chemistry Laboratory, Yale University, New Haven, Conn.
Music School, Smith College, Northampton, Mass.

Dennison & Hirons, New York City
Beaux Arts Institute of Design, Beaux Arts Society, New York City
Rye County Day School, Rye
Valley Stream School, Valley Stream

O. W. & H. B. Dryer, Rochester
Fairport High School, Fairport
East Rochester Grade School and Gymnasium, East Rochester
Honeoye Falls New Grade and High School, Honeoye Falls

Joseph E. Fronczak, Buffalo
Villa Maria Academy and Convent, Buffalo
Our Lady of Czestochowa Parochial School, Cheektowaga
St. Stanislaus Kostka Elementary School, Rochester

August Henry Galow, Huntington
Lincoln School, Huntington Station
Franklin Square School, Hempstead
Central School, South Huntington

Clarence H. Gardinier, Albany
New Quadrangle Group and Faculty Houses, St. Stephen's College, Annandale-on-Hudson
High and Grade School, Schuylerville
High and Grade School Unit, Rhinebeck

Archibald F. Gilbert, New York City
Lowville Academy and Grade School, Lowville
Alexandria Bay Grade and High School, Alexandria Bay
Granville High School, Granville

Thomas L. Gleason, Albany
College of St. Rose, Albany
Public School No. 27, Albany
Cathedral Academy, Albany

Wm. H. Gompert, New York City
New York Training School for Teachers, New York City
DeWitt Clinton High School, New York City
Theodore Roosevelt High School, New York City

Goodwillie & Moran, New York City (also Montclair, N. J.)
Central Grade School, Glen Ridge, N. J.
Linden Avenue School, Glen Ridge, N. J.
St. Luke's Parish School, Montclair, N. J.

Gordon & Kaelber, Rochester
Medical School and Hospital, University of Rochester, Rochester
New group of twelve buildings, Mens College, same
Benjamin Franklin High School, Rochester

Robert R. Graham, Middletown
Central Valley Junior High and Grammar School, Central Valley
Germantown High and Grade School, Germantown
Pine Island Central Rural High and Grammar School, Pine Island

Edw. B. Green & Sons—A. H. Hopkins, Buffalo
Kibler High School, Tonawanda
Nichols Country Day School for Boys, Buffalo
Brooklyn Avenue School, Union Street School, and Hutchins-South Jackson Streets School, Batavia

Edward Hahn, Hempstead
Floral Park Elementary School, Floral Park
The Mamaroneck High School, Mamaroneck
Floral Park-Bellrose Grade and Junior High School, Floral Park-Bellrose

Earl Hallenbeck, Syracuse
Liverpool High School, Liverpool
Canastota High School, Canastota
Stackbridge Valley School, Munnsville

Haskell & Considine, Elmira
Horseheads Junior and Senior High School, Horseheads
School for District No. 4
School for District No. 6

Helmle, Corbett & Harrison, New York City
Theodore Roosevelt High School, New York City (Associate Architect)
DeWitt Clinton High School, New York City (Associate Architect)
Far Rockaway High School, New York City (Associate Architect)

John Mead Howells, New York City (Originally Howells & Stokes)
Music Department and Memorial Gateway, Harvard University, Cambridge, Mass.
Administration Building, Carnegie Swimming Pool and Memorial Gateway, Yale University, New Haven, Conn.
St. Paul's Chapel, Columbia University, New York City

Paul Hueber, Syracuse
St. John the Baptist School, Syracuse
St. Brigiol's School, Syracuse
St. Mary's School, same

Pau F. Jagow, Lynbrook
Lynbrook Grade School, Lynbrook
Lakeview Grade School, Malverne
Rhame Avenue Grade School, East Rockaway

Louis Jallade, New York City
Grade School, Scarsdale
Summer Training School Group, Blue Ridge, N. C.
Gymnasium, Union Theological Seminary, New York City

Oliver R. Johnson, Jamestown
Lakewood High School, Lakewood
Westfield High School, Westfield
Ripley High School, Ripley

Johnstone & Eggert, North Tonawanda
Highland School, Tonawanda
Wurlitzer School, North Tonawanda
Ironton School, North Tonawanda

William H. Jones, Yonkers
Church and School of Our Lady of Refuge, Bronx, New York City
Parochial School for the Parish of St. Denis, Yonkers
Parochial School for the Parish of the Immaculate Conception, Stapleton, Staten Island

L. J. Kaley, Binghamton
Harry L. Johnson School, Johnson City
Christopher Columbus School, Binghamton (Associate Architect)
Hooper School, Endwell (Associate Architect)

F. J. & W. A. Kidd, Buffalo
East High School, Buffalo
Riverside High School, Buffalo
Kenmore High School, Kenmore

Beverly S. King, New York City
Library, Carthage College, Carthage, Ill.
The Pingray School, Elizabeth, N. J.
Public School, Garnersville

Melville L. King, Syracuse
Solvay High School, Solvay
East Syracuse High School, East Syracuse
Continuation School, Syracuse

Frank W. Kirkland, Rome
Columbus Grade School, Rome
DeWitt Clinton Grammar and Grade School, Rome
Forestport Union Free School, District No. 10, Forestport

Knappe & Morris, New York City
Stamford High School, Stamford, Conn.
St. Teresa's Parochial School, North Tarrytown
Hendrick Hudson High School, Montrose

A. Lawrence Kocher, New York City
Grade School, Pennsylvania State College, State College, Pa.
Dairy Barn, same
Grade School, Berwick, Va.

T. I. Lacey & Son, Binghamton
East Junior High School, Binghamton
Addition to High School, Endicott
Henry B. Endicott Grade School, Endicott

W. W. La Chance, Niagara Falls
17th Street Public School, Niagara Falls
Ferry Avenue Public School, Niagara Falls
Center Avenue Public School, Niagara Falls

Simon Larke & Russell G. Larke, Niagara Falls
Hyde Park Grade School, Niagara Falls
Also schools in association with others, cooperating as Associated Architects of Niagara Falls

Electus D. Litchfield, New York City
Macalester College Group, St. Paul, Minn.: General Group Plan for future development; Boys' Dormitory, Gymnasium, and Power House

Edward W. Loth, Troy
St John's Parochial Academy, Rensselaer
St. John's Parochial Junior High School, Rensselaer
Public School No. 12, Troy

Ludlow & Peabody, New York City
Group of five buildings, George Peabody College for Teachers, Nashville, Tenn.
Group of seven buildings, Hampton Institute, Hampton, Va.
Gymnasium and other buildings, Stevens Institute, Hoboken, N. J.

Henry J. McGill & Talbot F. Hamlin, New York City
Brescia Hall (dormitory) and Science Hall, College of New Rochelle, New Rochelle
Convent and Parish Hall, SS. Simon and Jude's Parochial Grade School, Brooklyn
Ursuline School for Girls (Academy), New Rochelle

W. Philip McGovern, New York City
St. Francis' College, Brooklyn
St. Mark's School, Sheepshead Bay
Resurrection School, Gerrittsen Beach

McKim, Mead & White, New York City
Harvard Business School, Boston, Mass.
Olin Memorial Library, Wesleyan College, Middletown, Conn.
Chemistry Building, Columbia University, New York City

Chas. F. Obenbach, Niagara Falls
Administration Building, Board of Education, Niagara Falls
Niagara Falls High School, Niagara Falls (Associate Architect)
North Junior High School, Niagara Falls (Associate Architect)

Oberlies & Lorenz, Rochester
Nazareth Academy, Rochester
St. Boniface School, Rochester
St. John the Baptist School, Lockport

James W. O'Connor, Architect; **James F. Delany & Paul Schulz,** Associates, New York City
Complete group, Manhattan College, New York City
La Salle Military Academy, Oakdale
Complete group, All Hallows Institute, New York City

Gerald Jos. O'Reilly, New York City
Citrus Grove Grade School, Miami, Fla.
Lemon City Agriculture and Trade High School, Miami, Fla.
Larkin Public School—Little River Public School, Larkin, Fla.

Peabody, Wilson & Brown, New York City
Westbury High School, Westbury
Grade School, Cold Spring Harbor
Grade School, Woodbury

Pember & Demers, Albany
Utica Country Day School, New Hartford
Lake Placid High School, Lake Placid
Public School No. 20, Albany

Pierce & Bickford, Elmira
South Side High School, Elmira
Elm Street School, Waverly
Cook Academy Gymnasium, Montour Falls

Charles A. Platt, New York City
Library, University of Illinois, Urbana, Ill.
Architectural Building, same
George Washington Hall, Phillips Academy, Andover, Mass.

Wilson Potter, New York City
High School, Bristol, Conn.
High School, Geneva
High School, Oneida

Randall & Vedder, Syracuse
Danforth Grade and Normal School, Syracuse
Washington Irving Grade School, Syracuse
Sayre High School, Sayre, Pa.

Rasmussen & Wayland, New York City
Bernardsville High School, Bernardsville, N. J.
Allendale Grade School, Allendale, N. J.
Wilson Borough Junior-Senior High School, Easton, Pa.

Victor Reeser, Inc., New York City
Group of buildings, St. Joseph's School for the Instruction of the Blind, Jersey City, N. J.: main building, annex and dormitories

Robert J. Reiley, New York City
Cathedral High School, New York City
Girls' Catholic High School, Brooklyn
St. Jean Baptist School, New York City

Marcus T. Reynolds, Albany
School Four, Albany
William I. Hackett Junior High School, Albany
Albany Academy Group, Albany

Ralph M. Rice, New York City
West Street Grade School, Newburgh
Chestnut Street School, Newburgh
Addition to Beacon High School, Beacon

James Gamble Rogers, New York City
Northwestern University Group, Chicago, Ill.
Harkness Memorial, Yale University, New Haven, Conn.
Sterling Memorial Library, same

Palmer Rogers, New York City
Northside High School, Corning
High School and Grade School, Addison
High School, Painted Post

Rossiter & Muller, New York City
Scarsdale High School, Scarsdale
Foxmeadow Grade School, Scarsdale
Addition to Greenburgh Grade School, District No. 6, Scarsdale

William L. Rouse, New York City
School and Settlement House, Federation Settlement House, New York City
School and Settlement House, The Madison House, New York City
Addition to Hebrew Technical Institute, New York City

J. M. Ryder, Schenectady
Scotia High School, Scotia
St. Johnsville High School, St. Johnsville
Stillwater High School, Stillwater

Salvati & LeQuornik, Brooklyn
St. Clare Parochial School, New York City
Our Lady of Mt. Carmel Parochial School, Mt. Vernon
Mary Help of Christians School, New York City

A. W. E. Schoenberg, Olean
Grammar Schools, Olean
Richburg High School, Richburg
Allegany High School, Allegany

Frederick J. Schwarz, New York City
St. Joseph's Roman Catholic School, Bayonne, N. J.
Holy Trinity School, Yonkers
Holy Rosary Roman Catholic School, Passaic, N. J.

Alexander Selkirk, Albany
Albany College of Pharmacy, Albany
Public Grade and High School, Delmar
Public Grade School No. 23, Albany

Edward C. Smith, Poughkeepsie
Christopher Columbus Grade School (Public School No. 3), Poughkeepsie
Warring Grade School (Public School No 10), Poughkeepsie
Grade and High School, Arlington

W. H. Spaulding, Jamaica
Grade School, Union Free School District No. 13, Valley Stream
Grade School, Common School District No. 3, East Meadow
Grade School, Union Free School District No. 27, West Hempstead

Starrett & Van Vleck, New York City
White Plains High School, White Plains
Isaac E. Young Junior High School, New Rochelle
George Inness Junior High School, Montclair, N. J.

Philip Steigman, Brooklyn
Yeshiva D'Brooklyn (High School and College), Brooklyn
Yeshiva Torah Vo-Daath (High School and College), Brooklyn
Yeshiva Isaac Jacob Reiners (High School and College), Brooklyn

Herbert C. Swain, Buffalo
Parker High School, Clarence
Eden High School, Eden
Silver Springs High School, Silver Springs

Thompson, Holmes & Converse, New York City
New group of buildings, Hunter College of the City of New York, New York City
School of Business, College of the City of New York, New York City
Dalton High School, Dalton, Mass.

Edward Lippincott Tilton, New York City
Welch Medical Library, Johns Hopkins University, Baltimore, Md.
Library Building, University of Notre Dame, Notre Dame, Ind.
Library Building, Queens University, Kingston, Ontario, Canada

Tooker & Marsh, New York City
High School, Patchogue
High School, North Tonawanda
High School, Bellows Falls, Vt.

Wm. B. Tubby, New York City
Roslyn High School, Roslyn
Roslyn Grade School, Roslyn
Bedford Junior High School, Westport, Conn.

Hobart B. Upjohn, New York City
Group of eight buildings, North Carolina State College, Raleigh, N. C.
Group of five buildings, St. Catherine's School for Girls, Richmond, Va.
Junior-Senior High School, Roanoke Rapids, N. C.

E. P. Valkenburgh, Middletown
Albert Street Grade School, Middletown
Woodbourne Grade School, Woodbourne
South Fallsburg High School, South Fallsburg

John V. Van Pelt, New York City
Gennadeion Library Group, American School of Classical Studies in Athens (Associate Architect)
School and Convent, Church of the Immaculate Conception, Tuckahoe
Orangeburg Grade School, Orangeburg

Theodore Visscher & James Burley, New York City
Alumni Administration Building, Lehigh University, Bethlehem, Pa.
Christmas-Saucon Hall, School of Business Administration, same
Science Building, Hampden-Sidney College, Hampden-Sidney, Va.

C. Edward Vosbury, Binghamton
Johnson City High School, Johnson City
Theodore Roosevelt School, Johnson City
Palm Harbor School, Clearwater, Fla.

J. Russell White, Albany
Grade and High School, Bolton Landing
Junior-Senior High School, Fort Edward
Grade and High School, Middleville

Frederic P. Wiedersum, Valley Stream
Union Free School, District No. 13, Valley Stream
Union Free School, District No. 24, Valley Stream
Valley Stream High School, District No. 1, Valley Stream

NORTH CAROLINA

Harry Barton, Greensboro
Senior High School, High Point
Auditorium, North Carolina College for Women, Greensboro
Music Building, same

Benton & Benton, Wilson
Selma Public School, Selma
High School, Tarboro
Fremont Public School, Fremont

G. R. Berryman, Raleigh
East Carolina Teachers College, Greenville
High School, Greenville
Consolidated School, Edgecombe County

Percy Bloxam, Salisbury
Group of buildings, Catawba College, Salisbury
Seven schools, Rowan County
Two schools, Rutherfordton County

T. E. Davis, Asheville
Sand Hill High School
Oakley School
French Broad School

Douglas D. Ellington, Asheville
Senior High School, Asheville
Auditorium, Park Avenue School, Asheville
Central Service Plant, Municipal College, Asheville

Eric G. Flannagan, Henderson
Charles Aycock School, Vance County
Woodland-Olney School, Woodland
Williamston High School, Williamston

Q. E. Herman, Hickory
Balls Creek Consolidated School, Catawba County, Newton
Valdese High School, Valdese
Longview High School, Hickory

James W. Hopper, Leaksville
Wentworth High School, Wentworth
Stoneville High School, Stoneville
Bethany Consolidated School, Bethany

Herbert B. Hunter, High Point
New group of buildings, High Point College, High Point: Administration Building, Science Building, Boys' and Girls' Dormitories
New group of buildings, Elon College, Elon: Administration Building, Auditorium, Christian Education Building, Library Building, and Science Building
New group of eleven buildings (contract awarded for first two), Atlantic Christian College, Wilson

M. R. Marsh, Charlotte
Thompson Orphanage Group, Charlotte
Fairview Elementary School, Charlotte
Mt. Pleasant High School, Mt. Pleasant

James A. Salter, Raleigh
Franklin Public School, Franklin
Administration Building, Methodist Orphanage, Raleigh
West Raleigh School, Raleigh

C. Gadsden Sayre, Greensboro
Hugh Morson High School, Raleigh
Boyden High School, Salisbury
Hall Fletcher High School, Asheville

NORTH DAKOTA

Bugenhagen & Molander, Minot
Minot Junior High School, Minot
Velva State Agriculture High School, Velva
Rugby High School, Rugby

Jos. Bell DeRemer, Grand Forks
New Gymnasium and Classroom Unit, Central High School, Grand Forks
Liberal Arts Building, University of North Dakota, Grand Forks
St. Mary's Parochial School, Grand Forks

Gilbert R. Horton, Jamestown
Mandan High School, Mandan
Wimbledon Grade and High School, Wimbledon
Kulm Grade and High School, Kulm

Van Horn & Ritterbush, Bismarck
Roosevelt Grade School, Bismarck
Boys' Dormitory, State Training School, Mandan
Girls' Dormitory, State Training Schcol, Mandan

OHIO

John Quincy Adams, Columbus
High and Junior High School, New Lexington
High School, Corning
Liberal Arts Building, College of St. Mary of the Springs, Columbus

John S. Adkins, Architect; **Hubert M. Garriott**, Associate Architect, Cincinnati
Riley Junior High School, Logansport, Ind.
Onward Consolidated School, Onward, Ind.
Denver Memorial Hall, Wilmington College, Wilmington

A. M. Allen & Co., Cleveland
Charles F. Brush High School, South Euclid
Maple Heights High School, Maple Heights
Southington Township School, Southington

Althouse & Jones, Mansfield
Mansfield Senior High School, Mansfield
Junior High School, Galion
Central Grade and High School, Leroy

Geo. W. Barkman, Hamilton
Three Grade Schools, Hamilton
High School, Harrison
Hanover Township Centralized School, Butler County

Paul Boucherle, Architect; **Walter J. Canfield,** Associate Architect; Youngstown
East High School, Youngstown
Rutherford B. Hayes Junior High School, Youngstown
Woodrow Wilson Junior High School, Youngstown

Jos. N. Bradford, University Architect, Columbus
Medical College Group, Ohio State University, Columbus
Education and Chemistry Buildings, same
Animal Husbandry Building, same

Gustave W Drach, Inc., Cincinnati
Victoria Hall (Nurses' Training School), Good Samaritan Hospital, Cincinnati
Heberle School, Cincinnati
Gymnasium and Auditorium Building, St. Bernard School, St. Bernard

Fechheimer & Ihorst, Cincinnati
Roosevelt Public School, Cincinnati
Group of buildings, Hebrew Union College, Cincinnati
Public School, Mariemont (model town)

H. O. Fullerton, Cleveland
Mexico Grade and High School, Mexico, N. Y.
West Leyden Central School, West Leyden, N. Y.
Constableville Grade and High School, Constableville, N. Y.

Fulton & Taylor, Cleveland
Berea High School, Berea
Parma Junior High School, Parma
Garfield Heights High School, Garfield Heights

Garber & Woodward, Cincinnati
Western Hills Junior-Senior High School, Cincinnati
Mt. Logan Junior High School, Chillicothe
Marietta Junior-Senior High School, Marietta

Abram Garfield, Cleveland
Institute of Pathology, Western Reserve University, Cleveland
Music Building, Lake Erie College, Painesville
Science Building and Dormitory, Kenyon College, Gambier

Gebhart & Schaeffer, Dayton
Emerson Junior High School, Dayton
Jackson Elementary School, Dayton
Ruskin Elementary School, Dayton

Edwin M. Gee, Toledo
Jones Junior High School, Toledo
Woodward High School, Toledo
Harvard School, Toledo

J. Kerr Giffen, Canton
Cambridge Hall, Muskingum College, New Concord
Dennison Junior-Senior High School, Dennison
Walnut Creek Grade School, Walnut Creek

Harry Hake, Cincinnati
Electrical College, Cincinnati University, Cincinnati
Law College, same
Administration Building, Lincoln Memorial University, Harrogate, Tenn.

Lawrence H. Hall, Springfield
Centralized High and Grade School, Pleasant Hill
Centralized High and Grade School, Jeffersonville
High School, Olive Branch, Clark County

Samuel Hannaford & Sons, Cincinnati
School for Crippled Children, Cincinnati
Gymnasium, Norwood High School, Norwood
Wyoming Grade and High School, Wyoming

Geo. M. Hopkinson, Cleveland
John Hay Commercial High School, Cleveland
Alexander Hamilton Junior High School, Cleveland
Charles Dickens Elementary School, Cleveland

Joseph C. Huber, Jr., Toledo
St. Stephen's Parish School, Toledo
Blessed Sacrament Parish School, Toledo
St. Ann's Parish School, Fremont

Keich, O'Brien & Hosker, Warren
Warren G. Harding High School, Warren
East Junior High School, Warren
West Junior High School, Warren

H. F. Kling & Son, Youngstown
N. H. Chaney Junior High School, Youngstown
Boardman High School, Boardman
Mineral Ridge Grade School, Mineral Ridge

M. M. Konarski, Akron
Spicer School, Akron
H. V. Hotchkiss School, Akron
Geo. T. Rankin School, Akron

Kunz & Beck, Inc., Cincinnati
Mt. St. Mary Seminary, North Norwood
St. Teresa School and Chapel, Cincinnati
St. Aloysius School, Elmwood Place

Langdon, Hohly & Gram, Toledo
Junior High School, Tiffin
"Marsh Foundation" Group, Van Wert: Main School Building, Instructors' homes, Cottages, Power Plant, etc.
Addition to Swanton School, Swanton

M. P. Lauer, Akron
Highland Park Grade School, Kenmore
F. E. Smith School, Kenmore
W. F. Rimer School, Kenmore

The J. E. Lewis Co., Canton
Malvern High School, Malvern
Beach City High School, Beach City
West Lafayete High School, West Lafayette

Office of Charles J. Marr, New Philadelphia
Canal Fulton High School, Canal Fulton
East Sparta High School, East Sparta
Bolivar High School, Bolivar

Miller & Reeves, Columbus
Bexley Elementary and Junior High School, Columbus
Upper Arlington School, Upper Arlington, Columbus (Howard Dwight Smith, Associate Architect)
St. Paul's Parish House Church School, Columbus

Frederick G. Mueller & Walter R. Hair, Hamilton
Catholic High School, Hamilton
St. Joseph's Parochial School, Hamilton
Junior High School, Hamilton

Peterson & Clarke, Steubenville
Grant Junior High School, Steubenville
Toronto High School, Toronto
Cross Creek District High School, Follansbee, W. Va.

F. J. Porter, Architect; **D. Roy Virtue,** Associate, Columbus
Rushcreek Memorial High School, Bremen
Piketon Rural High School, Piketon
Johnstown-Monroe Rural School, Johnstown

Potter-Gabele & Co., Cleveland
St. Cecilia's Parochial Grade School, Cleveland
St. Mary's Parochial Grade and High School, Massillon
Sacred Heart High School for Girls, E. Cleveland

Walter A. Rabold, Inc., Canton
Jefferson High School, R. R. No. 6, Dayton
Tuscarawas Grade and High School, Tuscarawas
Midvale High School, Midvale

Vernon Redding & Associates, Mansfield
Lincoln Junior High School, Canton
High School, Shelby
High School, Ashland

Richards, McCarty & Bulford, Columbus
South High School, Columbus
Four Marion Township schools, Franklin County
Columbus School for Girls, Columbus

T. Ralph Ridley, Akron
Wooster Senior and Junior High School, Wooster
Medina High School, Medina
Perkins Normal School, Akron

Riebel Sons & Matheny, Columbus
Groveport Grade and High School, Groveport
Crooksville High School, Crooksville
Reynoldsburg Grade and High School, Reynoldsburg

Anton Rieg, Cincinnati
St. George's Parochial School, Cincinnati
St. Joseph of Nazareth School, Cincinnati
St. Joseph's School, Cincinnati

Schenck & Williams, Dayton
Roosevelt High School, Dayton
Oakwood High School, Oakwood Village, Dayton
Oakwood Grade School, Oakwood Village, Dayton

Granville E. Scott, Norwalk
Community High School, Norwalk
High School, Willard
Washington High School, Utica

Howard Dwight Smith, Columbus
Stadium, Ohio State University, Columbus
Gymnasium and Field House, Wittenberg College, Springfield
One Senior High School, three Junior High Schools, and five Elementary Schools (for Board of Education), Columbus

Smull & Unger, Ada (also Bucyrus)
John H. Taft Gymnasium, Ohio Northern University, Ada
College of Law Building, same
Centralized High School, Zanesfield

Snyder & Babbitt, Architects and Engineers, Columbus
North High School, Columbus
Library and Assembly Hall, Indiana State Normal School, Muncie Training School, same

Jos. G. Steinkamp & Bro., Cincinnati
St. Xavier Library, St. Xavier College, Cincinnati
Field House, same
Auditorium and Addition, Garfield School, Cincinnati

S. P. Stewart & Son, Bowling Green
Grade and High School, Woodville
Dormitory for Women, Bowling Green State Normal College, Bowling Green
Senior High School, Bowling Green

Tietig & Lee, Cincinnati
Addition to Hyde Park School, Cincinnati
Addition to Kilgour School, Cincinnati
The Sayler Park School, Cincinnati

Harry W. Wachter, Toledo
Fourth Ward School, Monroe, Mich.
Williamsburg School, Williamsburg, Mich.
Trinity Lutheran School, Toledo

Walker & Norwick, Dayton
Lincoln Junior High School, Dayton
Elementary and High School, North Baltimore
High School, Gibsonburg

Walker & Weeks, Cleveland
Group of five buildings, The University School (preparatory school for boys), Cleveland
Group of two buildings, The Hathaway-Brown School (preparatory school for girls), Cleveland
Group of eleven buildings, Greater Wesleyan College, Macon, Ga.

Warner, McCornack & Mitchell, Cleveland
Group of buildings, University of Kentucky, Lexington, Ky.
Group of buildings (for Board of Education), Ashland, Ky.
Group of buildings (for Board of Education), Cleveland

Richard A. Zenk & Roy T. Campbell, Youngstown
Hubbard Grade School, Hubbard
Gustavus High and Grade School, Gustavus
Conneaut Grade School, Conneaut

OKLAHOMA

Jos. I. Davis, Oklahoma City
High School, Idabel
Eastern Oklahoma College Group, Wilburton
Girls' Dormitory, Oklahoma Baptist University, Shawnee

Chas. W. Dawson & A. E. Griffith, Muskogee
Gymnasium, Oklahoma School for the Blind, Muskogee
Dining Hall, Bacone College, Bacone (Dawson)
Parker Grade School, Fort Smith, Ark. (Dawson)

The Huseman Co., Chickasha
High School, Quay
High School, Tipton
High School, Hollister

Layton, Hicks & Forsyth, Oklahoma City
Library Building, University of Oklahoma, Norman
Capitol Hill Senior High School, Oklahoma City
Fine Arts Building, Oklahoma City University, Oklahoma City

A. J. Love & Co., Tulsa
High School, Wagoner
Barracks Building, Oklahoma Military Academy, Claremore
High School, Red Fork

Donald McCormick, Tulsa
Group of buildings, Cascia Hall, School of the Augustinian Fathers, Tulsa
School and Rectory, St. Francis Xavier Parish, Tulsa
Junior League Home and School for Convalescent Crippled Children, Tulsa

Albert S. Ross, Ada
Senior High School, Ada
Health Education Building, East Central State Teachers College, Ada
High School, Konowa

R. W. Shaw, Enid
Emerson Junior High School, Enid
Lincoln Elementary School, Enid
Gymnasium, Auditorium and Administration Building, Enid School System, Enid

Sorey & Vahlberg, Oklahoma City
Oklahoma Union Building, Oklahoma University, Norman
Library Building, Southeastern Teachers College, Durant
Gymnasium and Shops Building, Central High School, Oklahoma City

H. O. Valeur & Co., Muskogee
Junior High School, Muskogee
Grade School, Stone Bluff
Negro High School, Muskogee

OREGON

Joseph Jacobberger & Alf. H. Smith, Portland
Gymnasium Building, Columbia University, Portland
Chapel, Holy Name Convent, Seattle, Wash.
Rose City Park Grammar School, Portland

Knighton & Howell, Portland
Group of buildings, U. S. Grant High School, Portland
Junior High School, Salem
State Training School for Teachers, Independence

Lawrence, Holford, Allyn & Bean, Portland
Campus Layout, University of Oregon, Eugene: Women's Building, Science Building, Commerce Building, Basket Ball Pavilion, Dormitories, etc.
Laboratory Building and Children's Hospital, University of Oregon Medical School, Portland
Conservatory of Music and Dormitories, Whitman College, Walla Walla, Wash.

Sutton & Whitney, Architects; **Earl N. Dugan,** Associate Architect, Portland (also Tacoma, Wash.)
Jones Hall, College of Puget Sound, Tacoma, Wash.
Science Hall, same
Annie Wright Seminary, Tacoma

Thomas & Mercier, Portland
Memorial Union Building, Oregon State College, Corvallis
Rainier High School, Rainier
Union High School, Redmond

Tourtellotte & Hummel, Portland
High School, Boise, Idaho
High School, Medford
Normal Grade and Training School, Ashland

J. E. Wicks, Astoria
Captain Robert Gray Junior High School, Astoria
John Jacob Astor Junior High School, Astoria
Liberty Hall Astoria High School, Astoria

PENNSYLVANIA

Alden, Harlow & Jones, Pittsburgh
South Hills High School, Pittsburgh
Johnston School, Wilkinsburg
Allison School, Wilkinsburg

The Ballinger Co., Philadelphia
Public Grade School, Woodbury, N. J.
Addition to Junior High and Grade School, Marcus Hook
Alpha Sigma Phi Fratenity House, State College

P. A. Bartholomew, Pittsburgh
Conneaut Junior High School, Conneaut, Ohio
Derry Township High School, West Derry
Salina High School, Salina

The Office of George C. Baum, Philadelphia
New group of buildings, Gettysburg College, Gettysburg
New group of buildings, The Lutheran Orphans' Home of the South, Salem, Va.
Denhart Hall, Carthage College, Carthage, Ill.

Francis A. Berner, Pittsburgh
Grade School, Reserve Township, Allegheny County
Phi Gamma Fraternity House, Washington
Holy Name Parish School, Pittsburgh

Boyd, Abel & Gugert, Philadelphia
Auditorium and Gymnasium, Senior High School, Haverford Township
Junior High School, Haverford Township
Rosemont Grammar School and Auditorium, Radnor Township

Brenot & Hicks, Erie
School, Guys Mills
School, Cranberry Township
School, Harborcreek

Irwin T. Catharine, Philadelphia
Overbrook High School, Philadelphia
Group of two buildings: Simon Gratz Senior High School and Gillespie Junior High School, Philadelphia
Woodrow Wilson Elementary School and Theodore Roosevelt Elementary School, Pensauken, N. J.

Clepper & Clepper, Architects and Engineers, Sharon
Sharon Junior-Senior High School, Sharon
Wengler Avenue Grade School, Sharon
Sharpsville High School, Sharpsville

Cody & Kirby, Erie
West Millcreek High School, Erie County
Lawrence Park Grade and High School, Erie County
Lakewood Grade School, Erie County

Conrad C. Compton, Donora
Ludwick Grade School, Greensburg
Rostraven Township Junior High School, Pricedale
Castner Grade School, Donora

W. Holmes Crosby & Co., Oil City
Elizabeth Crawford School, Emlenton
Rouseville Public School, Rouseville
Third Ward Public School, Franklin

Office of J. A. Dempwolf, York
Shippensburg High School, Shippensburg
Bachman Memorial Parochial School, New Cumberland
St. John's Parochial School, York

Press C. Dowler, Pittsburgh
Sewickley High School, Sewickley
Hormont High School, Pittsburgh
Etna High School, Etna

W. G. Eckles Co., New Castle
Senior High School, Butler
Group of buildings, Grove City College, Grove City
R. A. Browne Dormitory, Westminster College, New Wilmington

Folsom, Stanton & Graham, Philadelphia
High School, Collingdale
Philip Baker School, Wildwood Crest, N. J.
Primary and Junior High School, Sharon Hill

Fred A. Fuller, Erie (formerly Fuller & Stickle)
Fairview High School, Fairview
Group of buildings, St. John Kanty College, Erie: Dining Hall, Dormitories and Chapel
Group of buildings, Hannon Hall Boarding School, Erie: Chapel, Dormitories and Classrooms

J. C. Fulton & Son, Uniontown
Religious Educational Building and Community Center, Sarah Jane Johnson Memorial Methodist Episcopal Church, Binghamton, N. Y.
Religious and Departmental Educational Building and Social Center, Trinity Reformed Church, Akron, Ohio
Departmental Educational Building, First Lutheran Church, Johnstown

John B. Hamme, York
Group of eight buildings, Hood College, Frederick, Md.
William Penn Senior High School, York
Junior-Senior High School, Brunswick, Md.

Hasness & Albright, Harrisburg
High School and W. H. Ramsey Grade School, Stroudsburg
W. W. Rupert Memorial Grade School, Pottstown
High School, Spring City

Heacock & Hokanson, Philadelphia
Lansdowne High School, Lansdowne
Gymnasium, Auditorium and Kindergarten, Germantown Preparative Meeting, Germantown, Philadelphia
Highland Grade School, Abington Township

Hersh & Shollar, Altoona
Altoona Senior High School Annex, Altoona
Keith Junior High School, Altoona
Ashland High School, Ashland

Hoffman-Henon Co., Philadelphia
La Salle College Group, Philadelphia
West Philadelphia Catholic High School for Girls, Philadelphia
North East Catholic High School for Boys, Philadelphia

R. G. Howard, Du Bois
Clearfield High School, Clearfield
Johnsonburg High School, Johnsonburg
Homer City High School, Homer City

Norman Hulme, Philadelphia
Philadelphia College of Pharmacy and Science, Philadelphia
Women's Homeopathic Hospital and Nurses' Training School, Philadelphia
Sharon Hill Public School, Sharon Hill

Hunter & Caldwell, Altoona
Fairview Grade School, Altoona
Gaysport School, Hollidaysburg
Consolidated School, Alexandria

Ingham & Boyd, Pittsburgh
Training School for Teachers, Board of Education, Pittsburgh
Administration Building, same
Group of buildings, Shady Side Academy, Pittsburgh: Dining Hall, Dormitory and Gymnasium

Jacoby & Everett, Allentown
Dormitories and Power Plant, Cedar Crest College, Allentown
Harrison and Morton High School, Allentown
High School, Nurses' College and Hospital, Sacred Heart Diocese, Allentown

Janssen & Cocken, Pittsburgh
Hygeia Hall, College of Wooster, Wooster, Ohio
School, Annunciation Parish, Pittsburgh
Alumni Hall, University of Pittsburgh, Pittsburgh

Emil R. Johnson & Clarence F. Wilson, Uniontown
Lafayette Junior High School, Uniontown
Chas. E. Boyle Elementary School, Uniontown
South Brownsville Senior High School, South Brownsville

Karcher & Smith, Philadelphia
Hicks Hall (engineering building), Swarthmore College, Swarthmore
Worth Hall and Girls' Dormitories, same
Women's Fraternity Lodges and Bond Memorial Building, same

Edward B. Lee, Pittsburgh
Morgantown High School, Morgantown, W. Va.
Clifford B. Connelley Trade School, Pittsburgh
Washington High School, Washington

W. H. Lee, Philadelphia
Temple University College Building, Philadelphia
Temple University Medical School, Philadelphia
Palmerton High School, Palmerton

C. Howard Lloyd, Harrisburg
William Penn High School Group, Harrisburg
Auditorium and Gymnasium, High School, Steelton
Steele Grade School, Harrisburg

Ludlow & Schwab, Architects; **C. J. Palmgreen,** Associate Architect
Langley High School, Pittsburgh
Versailles Boro School, Versailles
Sumac Street School, McKeesport

Magaziner, Eberhard & Harris, Philadelphia
Arter Hall, Allegheny College, Meadville
Murphy College Group, Sevierville, Tenn.: Administration Building, Recitation Hall, Boys' and Girls' Dormitories and Chapel
East Maine Conference Seminary, Bucksport, Me.

Mellor, Meigs & Howe, Philadelphia
Auditorium and Music Wing, Bryn Mawr College, Bryn Mawr
Science Hall, Haverford College, Haverford
Gymnasium, Pennsylvania Institute for the Deaf, Mount Airy, Philadelphia

Meyers & Johnson, Architects and Engineers, Erie
Wilson Junior High School, Erie
Rice Avenue Union High School, Girard
Harding Elementary School, Erie

Wm. M. Michler, Easton
Easton Senior High School, Easton
Schull Junior High School, Easton
Porter Grade School, Easton

C. R. Moffitt, McKeesport
Walnut Street School, Archer Street School and Market Street School, McKeesport
Hebrew Institute, McKeesport
Sacred Heart School, McKeesport

Frederick A. Muhlenberg, Reading
High School, Shillington
Four Grade Schools, Reading
Grade School, Hamburg

Emile G. Perrot, Philadelphia (also New York City)
Library, Fordham University, Fordham, N. Y.
Notre Dame Academy, Moylan
Academy of the Sisters of the Order of St. Dominic, Newburgh, N. Y.

John H. Phillips, Pittsburgh
Miles Bryan High School, McKees Rocks
Margaret Bell Miller School, Waynesburg
Harbrac Union High School, Brackenridge

Alexander I. Prawdzik, Scranton
St. Stanislaus Orphanage Group, Sheatown (near Nanticoke)
Visitation of Blessed Virgin Mary Parochial School, Dickson City
Sacred Heart Parochial School, Scranton

Price & Walton, Philadelphia
Philips Memorial Building, State Teachers College, West Chester
Friends School, Atlantic City, N. J.
Dormitory for Girls, Oak Grove Seminary, Vassalboro, Me.

Henry L. Reinhold, Jr., Philadelphia
Academy of the New Church, Bryn Athyns
High School, Windber
High School, Phoenixville

Ritcher & Eiler, Reading
Senior High School, Reading
Lebanon High School, Lebanon
Lebanon Valley College Group, Annville

Ritter & Shay, Philadelphia
Huntington High School, Huntington, W. Va.
Liberty High School, Bethlehem
David Rittenhouse Junior High School, Norristown

Ruhe & Lange, Allentown
Library, Muhlenberg College, Allentown
Science Building, same
Central Junior High School, Allentown

Scholl & Richardson, Reading
Southern Junior High School, Reading
Annville High School, Annville
Thorndale School, Downingtown

Henry Y. Shaub, Lancaster
George Ross Grade School, Lancaster
Manheim High School
West Lampeter Vocational High School, Lampeter

Simon & Simon, Philadelphia
Swedesboro High School, Swedesboro, N. J.
Haddonfield High School, Haddonfield, N. J.
Curtis Hall (engineering school), Drexel Institute, Philadelphia

H. Rex Stackhouse & W. W. Donohoe, Philadelphia
North Wildwood High School, North Wildwood, N. J.
A. V. Wood Gymnasium, Brunswick, Ga.
Middle Township High School, Cape May Court House, N. J.

James T. Steen & Sons, Pittsburgh
David B. Oliver Junior-Senior High School, Pittsburgh
Herron Hill Junior High School, Pittsburgh
Blaw-Knox Grade School, Blaw-Knox

Louis Stevens, Pittsburgh
Chatham Elementary School, Pittsburgh
Grade School, Overbrook, Allegheny County
Dormitory, Polk State School, Polk

Stewardson & Page, Philadelphia
Laboratory of Anatomy and Physiological Chemistry, University of Pennsylvania, Philadelphia
Dormitories, same
Dormitory, Haverford College, Haverford

G. W. Stickle, Erie
New group of buildings, Gannon Hall Boarding School, Erie
New building, St. John Kanty College, Erie
New group of buildings, St. Mary's College, North East

Albert L. Thayer, New Castle
Old Main Memorial, Westminster College, New Wilmington
George Washington Junior High School, New Castle
Lehman High School, Canton, Ohio

Horace Trumbauer, Philadelphia
Two new groups, Duke University, Durham, N. C.
Irvine Auditorium, University of Pennsylvania, Philadelphia
Ogontz School for Girls, Rydal

Van's Engineering Service (Henry M. Rogers, Architect), Blairsville
Ebensburg High School, Ebensburg
Washington Township High School, Apollo
Washington Township Grade School, Apollo

Frank R. Watson, Edkins & Thompson, Philadelphia
Group of buildings, Ursinus College, Collegeville: Dormitory Group, Gymnasium and Dining Hall
Dover High School, Dover, Del.
Oaklyn Public School, Oaklyn, N. J.

Ralph E. White, Philadelphia
Bryn Mawr Grade School, Bryn Mawr
Wynnewood Road Grade School, Wynnewood
Additions to Senior High School, Ardmore

W. Ward Williams, Pittsburgh
Junior High School, Ambridge
Grade School, Baden
Addition to High School, Pitcairn

RHODE ISLAND

Walter F. Fontaine, Woonsocket
Woonsocket Junior High School, Woonsocket
College of Mount St. Charles, Woonsocket
St. Anthony's School, New Bedford, Mass.

Howe & Church, Providence
Dormitory, St. George's School, Middletown
Junior High School, **Bristol**
Gymnasium, Brown University, Providence

Monahan & Meikle, Pawtucket
Senior High School, Pawtucket
Samuel Slater Junior High School, Pawtucket
Joseph Jenks Junior High School, Pawtucket

William R. Walker & Son, Providence
Senior High School, Cranston
Rhode Island College of Education, Providence
Junior High School, East Providence

SOUTH CAROLINA

F. H. & J. G. Cunningham, Greenville
Brevard High School, Brevard, N. C.
Stone School, Greenville
Woodruff High School, Woodruff

H. D. Harrall, Bennettsville
Elementary School, Dillon
High School, Latta
Gymnasium, Elementary Colored School, Bennettsville

J. Carroll Johnson, Columbia
Group of buildings, University of South Carolina, Columbia: Sloan College, Field House, Melton Memorial Observation; additions to and restoration of Library
Three Schools, Lancaster, S. C.

Lafaye & Lafaye, Columbia
Columbia College, Columbia
Shandon School, Columbia
High School, Summerville

Rudolph E. Lee, Clemson College
Women's Dormitory, University of South Carolina, Columbia
Girls' Dormitory, Lander College, Greenwood
Engineering Building, Clemson Agricultural and Mechanical College, Clemson College

J. D. Newcomer, Charleston
St. Paul's High School, St. Paul Parish, Charleston County
Ridgeland High School, Ridgeland
Rosemont School, Rosemont

J. E. Sirrine & Co., Greenville
Dormitory, Furman University, Greenville
Dining Hall, same
Athletic Building, same

James B. Urquhart, Columbia
Senior High School, Columbia
Junior High School, Columbia
Beaufort High School, Beaufort

W. Paul Williams, Spartanburg
High School, Duncan
High School, Inman
Colored Grammar School, Spartanburg

Chas. C. Wilson, Columbia
Entire group of buildings, Meredith College, Raleigh, N. C.
New group of buildings, Limestone College, Gaffney
Model Grammar School, Spartanburg

SOUTH DAKOTA

Walter J. Dixon, Mitchell
Tyndall High School, Tyndall
Auditorium, Yankton High School, Yankton
Kimball Grade and High School, Kimball

Geo. F. Fossum, Aberdeen
College Hall, Spearfish Normal School, Spearfish
Simmons Elementary School, Aberdeen
High School, Hecla

Hugill & Blatherwick, Sioux Falls
Gymnasium and Armory Building, University of South Dakota, Vermilion
High School, Pierre
High School, Salem

F. C. W. Kuehn, Huron
Artesian Public School, Artesian
Jefferson Grade School, Huron
Wilson Grade School, Huron

Perkins & McWayne, Sioux Falls
Library, State College of Agriculture and Mechanic Arts, Brookings
Auditorium, University of South Dakota, Vermilion
Washington High School, Sioux Falls

TENNESSEE

Alsop & Callanan, Memphis
Hulbert Separate School District, Hulbert, Ark.
Tuscumbia High School, Tuscumbia, Ala.
Rolling Fork Consolidated School, Rolling Fork, Miss.

George Awsumb, Memphis (Successor to Pfeil & Awsumb)
South Side High School, Memphis
L. C. Humes High School, Memphis
Hernando Consolidated Grade and High School, Hernando, Miss.

Baumann & Baumann, Knoxville
Maynard School, Knoxville
Austin High School, Knoxville
Park High School, Knoxville

Bearden & Crutchfield, Chattanooga
Dixie Portland Memorial School, Richard City
East Lake Junior High School, Chattanooga
Park Place Grammar School, Chattanooga

Coile & Cardwell, Johnson City
North Side School, Johnson City
Crescent Grammar School, Greeneville
Gymnasium, Tusculum College, Tusculum

Allen N. Dryden, Kingsport
Dobyns-Bennett High School, Kingsport
High School, Gate City, Va.
Church School, Rogersville

R. H. Hunt Co., Chattanooga (also Dallas, Texas)
McFarlin Memorial Auditorium, Southern Methodist University, Dallas, Texas
High School, Huntsville, Ala.
Training School, East Tennessee State Teachers College, Johnson City

Manley & Young, Knoxville
Administration Building, Tennessee Wesleyan College, Athens
Monroe County High School, Sweetwater
Harriman High School, Harriman

M. E. Parmelee, Knoxville
Gymnasium, Mars Hill College, Mars Hill, N. C.
Melrose Dormitory, same
Brown Dormitory, same

Gordon L. Smith, Chattanooga
Joseph E. Smith Elementary School, Chattanooga
Addition to Dickinson Junior High School, Chattanooga
Recreation Building, McCallie School, Chattanooga

Geo. D. Waller, Nashville
Group of three buildings, Montgomery Bell Academy, Nashville
Two Elementary Schools, Davidson County
Jones Avenue Elementary School, Nashville

TEXAS

Ralph H. Cameron, San Antonio
Main Avenue High School, San Antonio
McAllen High School, McAllen
Luling Public School, Luling

Lamar Q. Cato, Houston
George Washington Junior High School, Houston
Stonewall Jackson Junior High School, Houston
Woodrow Wilson Elementary School, Houston

Curtis & Thomas, Dallas
High School, Carthage
Second Ward School, Paris
East Paris School, Paris

DeWitt & Washburn, Dallas
Woodrow Wilson High School, Dallas (Associate Architects)
Sunset High School, Dallas (Associate Architects)
School of Theology, Southern Methodist University, Dallas (Associate Architects)

Leo M. J. Dielmann, San Antonio
Holy Ghost Convent, San Antonio
Manual Arts High School, Yoakum
Immaculate Heart of Mary School, San Antonio

T. J. Galbraith, Dallas
Hillsboro High School and Junior College, Hillsboro
Stephen J. Hay Elementary School, Dallas
Shawnee Park Elementary School, Graham

Giesecke & Harris, Houston
New group of buildings, Primary-Junior High School—Senior High School and Junior College, Edinburg
New unit, Senior High School, Austin
High School, Brenham

Herbert M. Greene, LaRoche & Dahl, Dallas
Scottish Rite Dormitory, University of Texas, Austin
Biology Building, same
Labcratory, Medical College, Galveston

Hardy & Curran, Corpus Christi
Corpus Christi Senior High School, Corpus Christi
Del Mar Grade School, Corpus Christi
Mexican Grade School, Corpus Christi

Wyatt C. Hedrick, Inc., Fort Worth
New group of buildings, Texas Technological College, Lubbock: Administration Building, Chemistry Building, Engineering Building and Textile Building

Henry Norton June, Corpus Christi
Group of buildings, Agricultural and Mechanical College of Texas, College Station: Three Dining Halls, Law and Puryear Halls (dormitories) and Athletic Stadium

H. F. Kuehne, Austin
Llano High School, Llano
Group of seventeen buildings, Austin State School, Austin
Smithville High School, Smithville

C. H. Leinbach, Dallas
Atlanta High School, Atlanta
Two Elementary Schools, Mexia
Wilmer Hutchins High School, Dallas

Mark Lemmon, Dallas
Thomas Jefferson Junior High School, Port Arthur
Woodrow Wilson High School, Dallas (Associate Architect)
Sunset High School, Dallas (Associate Architect)

Livesay & Wiedemann, Beaumont
Daisetta High School, Daisetta
Beaumont Public Schools, Beaumont
South Park School (Giles School), Beaumont

John McLelland, Houston
Park Junior High School, Houston
Clinton High School, Houston
Pasaden High School, Houston

Jos. W. Northrop, Jr., Houston
Educational Building, First Evangelical Church, Houston
Group of buildings, Trinity Episcopal Church, Marshall
Educational Building, Christ Evangelical Church, Houston

Page Bros., Austin
Two Junior High Schools, Beaumont
High School, Georgetown
Administration Building, North Texas State Teachers' College, Denton

Harry D. Payne, Houston
School Building Program, Houston Independent School District (Supervising Architect)
Baytown Junior High School, Baytown
Robert E. Lee High School, Goose Creek

Peters, Haynes & Strange, Lubbock
High School, Lubbock
High School, Lamesa
High School, Odessa

Phelps & Dewees, San Antonio
Eight Junior High Schools, San Antonio
San Angelo Junior College, San Angelo
Brownsville High School, Brownsville

E. F. Rittenberry & Co., Amarillo
Education Building, West Texas State Teachers College, Canyon
Hereford High School, Hereford
Seven Grade and Senior High Schools, Amarillo

Milton W. Scott & Co., Waco
South Waco Junior High School, Waco
Group of four buildings, State Home for Dependent and Neglected Children, Waco
Gymnasium, High School, Waco

Paul G. Silber & Co., San Antonio
Educational Building, First Presbyterian Church, San Antonio
Administration Building, Clifton College, Clifton
High School, Alice

Harvey P. Smith, San Antonio
Alamo Heights Elementary and Junior High School, Alamo Heights, San Antonio
San Benito High School, San Benito
Dormitory, Lutheran Concordia College, Austin

Voelcker & Dixon, Wichita Falls
Zundelowitz Junior High School, Wichita Falls
High School, Olney
High School, Henrietta

Wm. Ward Watkin, Houston
Laboratory of Chemistry, Rice Institute, Houston
Six Junior and Senior High Schools, Houston
Texas Technological College Group, Lubbock

UTAH

Cannon & Fetzer, Salt Lake City
West High School, Salt Lake City
Grantsville High School, Grantsville
Addition to South Junior High School, Salt Lake City

Joseph Nelson, Provo
Nephi High School, Nephi
Heber J. Grant Library, Brigham Young University, Provo
Provo High School, Provo

Eber F. Piers, Ogden
Central Junior High School, Ogden
St. Joseph's Parochial School, Ogden
West Weber Grade School, Ogden

Scott & Welch, Salt Lake City
Bryant Junior High School, Salt Lake City
Sandy Junior High School, Sandy
Central School, Nampa, Idaho

VERMONT

Frank Lyman Austin, Burlington
Cathedral High School and Gymnasium, Burlington
Junior High School, Burlington
Winooski High School, Winooski

Arthur H. Smith, Rutland
Administration Building, State Normal Training School, Castleton
Girls' Dormitory, same
Gymnasium, Burr and Burton Seminary, Manchester

VIRGINIA

Carneal & Johnston, Richmond
New buildings, Virginia Polytechnic Institute, Blacksburg
New buildings, Virginia Military Institute, Lexington
Blackstone Military Academy, Blackstone

T. J. Collins & Son, Staunton
Memorial Hall, Staunton Military Academy, Staunton
Complete School Group, Fishburne Military School, Waynesboro
Gymnasium and Academic Group, Augusta Military Academy, Fort Defiance

Clarence B. Kearfott, Bristol
New group of buildings, Arlington Hall (School for Girls), Arlington County
Science Hall and Literary Group, Virginia Intermont College, Bristol
Appalachia High School, Appalachia

Peebles & Ferguson, Norfolk
Ruffner Junior High School, Norfolk
Phi Beta Kappa Memorial Hall, College of William and Mary, Williamsburg
Two Grammar Schools, Norfolk

Charles M. Robinson, Richmond
Harrisonburg High School, Harrisonburg
Richmond Normal School, Richmond
Wm. Barton Rogers Memorial Science Hall, College of William and Mary, Williamsburg

Louis Philippe Smithey, Roanoke
Wasena School, Roanoke
Addition to Jackson Junior High School, Roanoke
Addition to National Business College, Roanoke

WASHINGTON

Baker, Vogel & Roush, Architects and Engineers, Seattle
Washington High School, Pasco
American Methodist Episcopal Japanese Girls High School, Nagasaki, Japan
Lutheran Japanese Girls High School, Kumamoto, Japan

Bebb & Gould, Seattle
Eleven Academic Buildings and Library, University of Washington, Seattle
Washington State Normal School Group and Library, Bellingham
St. Nicholas Private School for Girls, Seattle

Chas. I. Carpenter, Spokane
New group of buildings, Ellensburg State Normal School, Ellensburg: Dormitories, Dining Hall, Library and Gymnasium

Wm. W. deVeaux, Yakima
Madison Grade School, Yakima
Selah High School, Selah
Addition to Garfield Grade School, Yakima

John Graham, Seattle
Sacred Heart School, Seattle
Physics Building, University of Washington, Seattle
St. Mary's Academy, Centralia

Hill & Mock, Tacoma
Morton McCarver Intermediate High School, Tacoma
Reconstruction of Puyallup High School and Addition to Junior High School, Puyallup
Sumner Grade School and Central Heating Plant, Sumner

C. Frank Mahon, Seattle
St. Mary's Catholic Parochial School, Aberdeen
Immaculate Conception Catholic Parochial School, Everett
Perpetual Help Catholic Parochial School, Everett

Wm. Mallis, Seattle
Yahoma High School, Maple Valley
Auburn High School, Auburn
Kent High School, Kent

Maloney & Bockerman, Yakima
Franklin Junior High School, Yakima
Sunnyside Grade School, Sunnyside
St. Patrick's Parish School, Walla Walla

F. A. Naramore, Seattle
Bryant Elementary School, Seattle
Alexander Hamilton Intermediate School, Seattle
Grover Cleveland Intermediate and Junior High School, Seattle

George M. Rasque, Spokane
Coeur d'Alene Junior High School, Coeur d'Alene, Idaho
Odessa High School, Odessa
Colville High School, Colville

Francis P. Rooney, Spokane
House of the Good Shepherd, Spokane
St. John's Academy, Colefax
Kellogg High School, Kellogg, Idaho

Stanley A. Smith, College Architect, Pullman
Group of buildings, State College of Washington, Pullman: The Commons, Men's Gymnasium and Home Economics Building

Sutton, Whitney & Dugan, Tacoma
Annie Wright Seminary, Tacoma
Jones Hall, College of Puget Sound, Tacoma
Science Hall, same

Whitehouse & Price, Spokane
West Valley High School, Millwood
Arlington Grade School, Hillyard, Spokane
Russell Grade School, Moscow, Idaho

Jos. H. Wohleb, Olympia
Lincoln Grade School, Olympia
Irene S. Reed High School, Shelton
William Winlock Miller High School, Olympia

Arnott Woodroofe, Spokane
Gymnasium, Fairfield High School, Fairfield
Grade School, District No. 98, Pierce County
Roy High School, Roy

WEST VIRGINIA

William Francis Diehl, Huntington
Douglas Senior and Junior High School, Huntington
Grant High School, Grant District, Cabell County, Milton
Gymnasium and Physics Education Building, Morris Harvey College, Barboursville

S. W. Ford, Clarksburg
Mannington High School, Mannington
Bridgeport High School, Bridgeport
Eagle District High School, Lumberport

Frampton & Bowers, Huntington
Elkins High School, Elkins
Oak Hill High School, Oak Hill
Martinsburg High School, Martinsburg

Edward Bates Franzheim, Wheeling
Warwood High School, Wheeling
Chemistry Building, Bethany College, Bethany
Colored Grade School, Triadelphia

Garry & Sheffey, Bluefield
Ramsey Junior High School, Bluefield
Fairview Junior High School, Bluefield
Mullens High School, Mullens

Carl Reger, Morgantown
Upshur County High School, Buckhannon
Reno District High School, Rowlesburg
Agnes Howard Hall, West Virginia Wesleyan College, Buckhannon

Warne, Tucker, Silling & Hutchison, Charleston
Charleston Senior High School, Charleston
Woodrow Wilson Junior High School, Charleston
Administration Building, West Virginia Collegiate Institute, Institute

Edward J. Wood & Son, Clarksburg
Sutton High School, Sutton
Weston Grade School, Weston
Despard School, Clarksburg

WISCONSIN

Auler, Jansen & Brown, Oshkosh
Oshkosh Vocational and Recreation Building, Oshkosh
Roosevelt Junior High School, Oshkosh
Ripon Primary School, Oshkosh

N. P. Backes, Milwaukee
St. Elisabeth School, Milwaukee
Holy Cross School, Milwaukee
St. John's School, Marshfield

Balch & Lippert, Madison
Winnebago Indian School, Neillsville
Mazomanie High and Grade School, Mazomanie
Religious Educational Building, Swiss Reformed Church, New Glarus

Peter Brust, Milwaukee
Alvernia High School, Chicago, Ill.
Mercy High School, Milwaukee
Ernest G. Miller Gymnasium, St. Francis Seminary, St. Francis

Foeller, Shober & Berners, Green Bay
East Side High School, Green Bay
Nicolet High School, West De Pere
West Bend High School, West Bend

Ferd. L. Kronenberg, Madison
Addition to Emerson School, Madison
St. Peter's School, Beaver Dam
St. Xavier School, Cross Plains

E. R. Liebert, Milwaukee
Grade School, Zoar Congregation, Milwaukee
Grade School, District No. 5, Custer, Mich.
Concordia College, Milwaukee

Merman & Skogstad, La Crosse
La Crosse Vocational School, La Crosse
Beloit Vocational School, Beloit
Lincoln Junior High School, La Crosse

Oppenhamer & Obel, Green Bay
Central School, Wausau
High School, Burlington
High School, Sheboygan Falls

Parkinson & Dockendorff, La Crosse
Purdy Junior High School, Marshfield
Junior High School, Waukesha
Catholic Central High School, La Crosse

Mark F. Pfaller, Milwaukee
St. Agnes Church and School Building, Milwaukee
Blessed Sacrament Church and School Building, Milwaukee
St. Dominic's School, Sheboygan

Charles Clark Reynolds, Green Bay
West Senior High School, Green Bay
Butte Des Morts Elementary School, Menasha
Irwin Elementary School, De Pere

Alvan E. Small, Madison
Lowell Grade School, Madison
Randall Grade School, Madison
Nakoma Grade School, Madison

Smith & Brandt, Manitowoc
Kiel Grade and High School, Kiel
Marion Grade and High School, Marion
Cunningham Elementary School, Beloit

Frank J. Stepnoski, Fond du Lac
St. Peter's Lutheran School, Fond du Lac
St. John's Catholic School, Little Chute
Holy Name Catholic School, Kimberly

Edward Tough, Madison
Mineral Point High School, Mineral Point
Randall Junior High School, Madison
Dudgeon Grade School, Madison

Martin Tullgren & Sons, Milwaukee
West Milwaukee High School, West Milwaukee
Humboldt Avenue Public School, Whitefish Bay
Hampton Road Public School, Whitefish Bay

Van Ryn & De Gelleke, Milwaukee
Central Vocational School, Milwaukee
Milwaukee University School, Milwaukee
Science Hall, Milwaukee-Downer College, Milwaukee

Carl Volkman, Eau Claire
High School, Bloomer
Public School, Eau Claire
Parochial School, Chippewa Falls

Guy E. Wiley, Milwaukee
Koscinszko Prevocational School, Milwaukee
Geo. H. Walker Junior High School, Milwaukee
Lincoln High School, Milwaukee

WYOMING

Wilbur A. Hitchcock, Laramie
Library, University of Wyoming, Laramie
Whiting School, Laramie
Men's Dormitory, University of Wyoming, Laramie

ALPHABETICAL AND CLASSIFIED LISTS OF MANUFACTURERS

Sales Executives in the Educational Equipment Field

The following selection of manufacturers together with the names of the officials in charge of sales has been made for the convenience of architects and school and college officials, for whom an alphabetical listing of the addresses of such manufacturers may be of value.

The numbers following certain names refer to pages in this book, on which further information may be found relative to the products of some of the leading manufacturers.

Abbott Laboratories, North Chicago, Ill.—Floyd K. Thayer, Mgr., Izal Sales Div.
Acme Partition Co., Inc., Oakland, Cal.—W. C. Grant, Sales Mgr.
Acme Shear Co., Bridgeport, Conn.—Thos. F. Conway, Asst. Secy.
Frank Adam Electric Co., 3650 Windsor Pl., St. Louis, Mo.—H. J. Reinhardt, Vice-Pres.
Henry T. Adams Mfg. Co., 8561 S. Chicago Ave., Chicago—Henry T. Adams.
The Adlerhurst Iron Co., West Haven, Conn.—John Adlerhurst, Pres. (See page 130)
Akatos, Inc., 114 Liberty St., New York—F. Rohde, Vice-Pres.
Alberene Stone Co., 153 W. 23d St., N. Y.—J. L. Kretzmer, V.-P. & Sales Mgr. (Pps. 131, 308)
Alma Furniture Co., High Point, N. C.—D. R. Parker, Gen. Mgr.
Aluminum Cooking Utensil Co., New Kensington, Pa.—George Peters, Mgr., Sales.
Alumoyd Sign and Signal Co., 255 E. 95th St., Chicago—R. A. Thompson, Pres. (See page 132)
American Abrasive Metals Co., 50 Church St., New York—R. P. Spooner, Secy. (See page 133)
American Airdry Corp., Detroit, Mich.—J. W. Vanderbeck. (See page 208)
American Blue Stone Co., 101 Park Ave., New York—Geo. W. Otis, Pres.
American Can Co., 120 Broadway, New York—Harry Craver, Vice-Pres.
American Crayon Co., Sandusky, Ohio—W. T. Schleicher, Sales Mgr.
American Fence Construction Co., 522 Fifth Ave., New York—W. F. Goodnough, Pres.
American Laundry Machinery Co., Cincinnati, Ohio—H. H. Miller, Vice-Pres.
American Playground Device Co., Anderson, Ind.—J. E. Wilkins, Secy.-Treas. (See page 218)
American Seating Co., 14 E. Jackson Blvd., Chicago—Van Wills, Vice-Pres.
American Tar Products Co., Pittsburgh, Pa.—P. L. Griffiths, Sales Mgr. (See page 209)
American Type Founders Co., Jersey City, N. J.—F. K. Phillips, Mgr., Education Dept.
American Writing Paper Co., Holyoke, Mass.—Russell S. Maddon, Gen. Sales Mgr.
Anchor Post Fence Co., Baltimore, Md.
A. H. Andrews Co., 107 S. Wabash Ave., Chicago—H. F. Hooper.
Annin and Co., Fifth Ave. and 16th St., New York—J. B. Knapp.
A. P. W. Paper Co., Albany, N. Y.—T. B. Wheeler, Vice-Pres. in Charge of Sales.
Arlington Seating Co., Arlington Heights, Ill.—C. E. McWhorter; C. E. Olsen.
Armco Culvert Mfrs. Assn., Middletown, O.—H. W. Rinearson, Gen. Mgr. (See page 219)
Armstrong Cork Co., Lancaster, Pa.—H. W. Prentis, Jr., V.-P. & Mgr. Sales.
Art Metal Construction Co., Jamestown, N. Y.—E. G. Keeling, Gen. Sales Mgr.
Associated Tile Mfrs., Graybar Bldg., New York—M. A. Illing, Secy.
Athey Co., 6003 W. 65th St., Chicago—L. G. Klee, Gen. Mgr.
E. C. Atkins & Co., Indianapolis, Ind.—N. A. Gladding, First Vice-Pres.
Atlanta Table Co., Atlanta, Ga.—R. L. Reed, Pres. and Treas.
Austral Window Co., 101 Park Ave., New York—W. W. Meyers, Gen. Mgr.
The Automatic File and Index Co., Green Bay, Wis.—C. W. Straubel, Sales Mgr.
Automatic Pencil Sharpener Co., 58 E. Washington St., Chicago—S. E. Collins, Gen. Mgr.
Badger Wire and Iron Works, Milwaukee, Wis.—Albert Haeger, Pres.
J. T. Baker Chemical Co., Phillipsburg, N. J.—R. A. Clark, Sales Mgr. (See page 336)
Barber Asphalt Co., Philadelphia, Pa.—C. W. Bayliss, Vice-Pres. (See pages 122, 123)

Barrett Co., 40 Rector St., New York—John Yoke, Gen. Sales Mgr.
L. Barth & Co., Inc., Cooper Square, New York—Richard Ratner, Pres. (See pages 282, 283)
Bausch & Lomb Optical Co., Rochester, N. Y.—J. Hammele, Gen. Sales Mgr. (See page 303)
Bell & Howell Co., 1801 Larchmont Ave., Chicago—H. B. Payne, Gen. Sales Mgr.
Benjamin Electric Mfg. Co., 120 S. Sangamon St., Chicago—W. D. Steele, Pres.
Berger Bros. Co., Philadelphia, Pa.—V. N. McMullin, Mgr. of Sales.
Berger Mfg. Co., Canton, Ohio—Geo. Galvin, Sales Mgr.
Bevin Bros. Mfg. Co., East Hampton, Conn.—S. A. Bevin, Secy.
Billings-Chapin Co., Cleveland, Ohio—Robert Reed, Sales Mgr.
Binney & Smith Co., 41 E. 42d St., New York—M. C. Falco, Executive Head.
J. Bishop & Co., Platinum Works, Malvern, Pa.—Paul C. Kerk, Sales Mgr.
S. Blickman, Inc., Weehawken, N. J.—Manuel Blickman, Treas.
Bonded Floors Co., Inc., Kearny, N. J.—H. G. Gooding, Vice-Pres.
C. E. Bradley Corp., Brattleboro, Vt.—Joe D. Hale, Secy.
Milton Bradley Co., Springfield, Mass.—E. O. Clarke, Sr., Gen. Mgr.
Bradley Washfountain Co., Milwaukee, Wis.—H. A. Mullett, Gen. Sales Mgr.
The Brooks Co., Cleveland, Ohio—E. K. Bryan, Gen. Mgr. (See page 270)
E. L. Bruce Co., Memphis, Tenn.—E. L. Fellman, Mgr. Better Merchandising Dept.
The Buckeye Blower Co., Columbus, Ohio—A. T. Holl, Sales Mgr.
Buffalo Forge Co., Buffalo, N. Y.—C. A. Booth, Sales Mgr.
F. J. Burns & Co., 1108 W. Randolph St., Chicago—F. J. Burns. (See page 310)
Samuel Cabot, Inc., Boston, Mass.—M. G. Bennett, Treas.
Cannon Mills, Inc., 70 Worth St., New York—J. W. Brady, Mgr., Woven Name Towel Dept.
Philip Carey Co., Cincinnati, Ohio—R. B. Crabbs, Vice-Pres.
Carter's Ink Co., Cambridge, Mass.—C. B. Gordon, Gen. Mgr.
Celotex Co., 645 N. Michigan Ave., Chicago—Geo. P Little, Mgr., Acoustical Dept.
Central Scientific Co., 460 E. Ohio St., Chicago—S. L. Redman, Sales Mgr.
Century Brass Works, Inc., Belleville, Ill.—A. G. Ruediger, Sales and Adv. Mgr.
Challenge Machinery Co., Grand Haven, Mich.—Burton S. Hanson, Vice-Pres. and Sales Mgr.
Chemical Toilet Co., Syracuse, N. Y.—W. E. Jaquith, Pres. (See page 134)
Chicago Gymnasium Equipment Co., 1830 W. Lake St., Chicago—T. A. Gross.
Chicago Hardware Foundry Co., North Chicago, Ill.—E. S. Hewitt, Gen. Sales Mgr.
Chicago Paper Co., 801 S. Wells St., Chicago—E. D. Levinsohn, Mgr., School Dept.
C. Christiansen, 2814 W. 26th St., Chicago.
C. F. Church Mfg. Co., Holyoke, Mass.—John L. Campbell, Sales Mgr.
Circle A Products Corp., Newcastle, Ind.—Arthur M. Simpson, Sales Mgr.
Clarke Sanding Machine Co., 3815 Cortland St., Chicago—Richard E. Slayter, Dir. of Sales.
Clay-Adams Co., 117 E. 24th St., New York—Lloyd T. Hillborn, Pres. (See pages 304, 305)
Clayton Mfg. Co., 1133 Broadway, New York—C. M. Bowes, Pres.
The Clemetsen Co., 3401 W. Division St., Chicago—A. F. C. Beckford, Sales Mgr.
James B. Clow & Sons, 201 N. Talman Ave., Chicago—W. E. Clow, Jr., Vice-Pres.
Coldwell Lawn Mower Co., Newburgh, N. Y.—R. W. Speiser, Gen. Sales Mgr. (See pages 160, 161)
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.—Geo. R. Porter, Sales Mgr., Autosan Div.
Columbia Mills, Inc., 225 Fifth Ave., New York—E. R. Rabb, Sales Mgr.
Columbia School Supply Co., Indianapolis, Ind.—C. C. Moore, Pres.
Continental Chemical Corp., Watseka, Ill.—J. H. Longshore, Sales Mgr.
Corning Glass Works, Corning, N. Y.—G. W. Drake, Mgr. Ind. and Lab. Div. (See page 309)
The George F. Cram Co., Indianapolis, Ind.—J. H. Beck, Sales Mgr.
Crane Co., 836 S. Michigan Ave., Chicago—H. W. Seymour, Gen. Mgr. of Sales.
Crown Chair Co., Evansville, Ind.—L. W. Snow, Secy.
Cyclone Fence Co., Waukegan, Ill.—H. G. Chapman, Gen. Sales Mgr.
Davey Tree Expert Co., Kent, Ohio—Martin L. Davey, Pres. and Gen. Mgr.
Dayton Safety Ladder Co., Cincinnati, Ohio—Jos. A. Scallan, Sales Mgr.
Detroit Atlas Portable Bleacher Seat Co., Detroit, Mich.—S. W. Mower, Gen. Mgr.
Detroit Graphite Co., Detroit, Mich.—B. B. Cannon, Mgr. Interior Paint Sales.
Detroit School Equipment Co., Holly, Mich.—W. E. Harry, Sales Mgr.
Detroit Steel Products Co., Detroit, Mich.—C. R. Raquet, Sales Mgr.
DeVoe & Raynolds Co., Inc., 1 W. 47th St., New York—E. D. Peck, V.-P. & Gen. Sales Mgr.
DeVry Corp., 1111 Center St., Chicago—F. Holmboe, Gen. Sales Mgr.
A. B. Dick Co., 720 W. Jackson Bldvd., Chicago. (See pages 264, 265)
Digestive Ferments Co., Detroit, Mich.—H. D. Dunham, Lab. Director.
Display Stage Lighting Co., Inc., 334 W. 44th St., New York—E. F. Kook, Mgr. (See page 271)
Henry Disston & Sons, Inc., Philadelphia, Pa.—Waldo C. Wright, Educational Director.

Jos. Dixon Crucible Co., Jersey City, N. J. (School Bureau)
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Weston Electrical Instrument Corp., 591 Frelinghuysen Ave., Newark, N. J. 318
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THE HART & HUTCHINSON COMPANY

VENEER-STEEL PARTITIONS

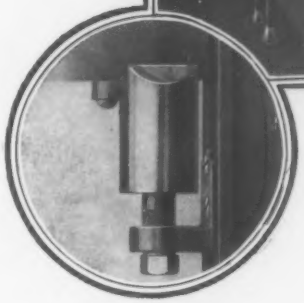
NEW BRITAIN,

Veneer-Steel TRADE MARK REG.

STEEL LOCKERS AND CABINETS

CONNECTICUT

AGENTS IN PRINCIPAL CITIES



POINTS TO THINK ABOUT

POINT ONE—

Heavy galvanized steel used exclusively. Tubular members sherardized inside and out. Hardware—handles and foot castings—solid white brass buffed bright.

POINT TWO—

A perfectly smooth flush-type, sanitary partition with no chance for dust or moisture to catch or hold.

POINT THREE—

No tin-pan slamming, rattle or vibration. Solidly filled core, bonded in cement prevents all noise.

POINT FOUR—

A ball bearing gravity hinge that closes door. Will not get sluggish in action and won't wear out. Needs lubrication only once in several years.

These are some of the reasons that make *Veneer-Steel Partitions* superior.

Write for complete details.

THE ABOVE ILLUSTRATIONS SHOW THE JOHN HARRIS HIGH SCHOOL, HARRISBURG, PA.

Architect
LAPPLEY & HORNBOSTEL,
Harrisburg, Pa.

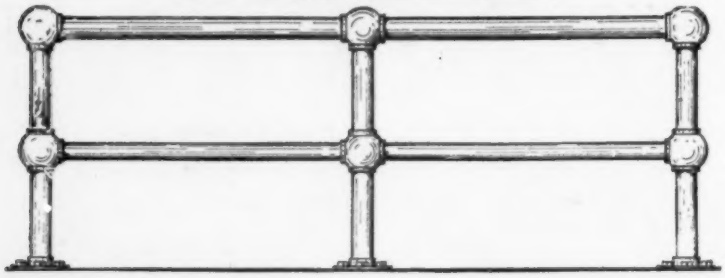
General Contractor
CHAS. W. STRAYER,
Harrisburg, Pa.

PIPE RAILING CONSTRUCTION CO., INC.

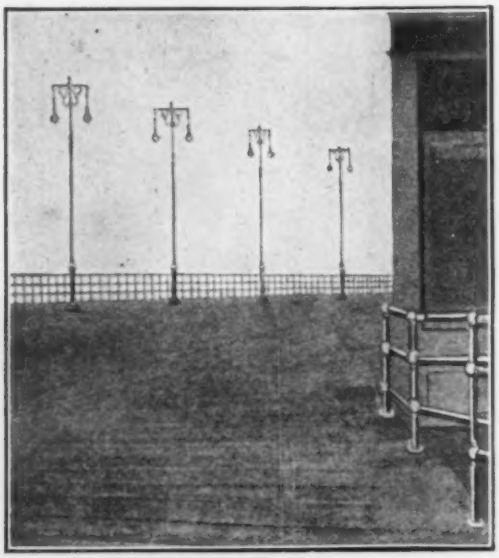
Pipe Railings for Iron or Concrete Stairs, Grandstands, Board Walks, Runways, Backstops, Goal Posts, Etc.

51–69 Sixth Street

LONG ISLAND CITY, N. Y.



This company is organized to manufacture and assemble pipe and fittings for every possible service except plumbing and steam fitting. With tons of black and galvanized pipe in stock, we can promise almost immediate shipment of any order, large or small.

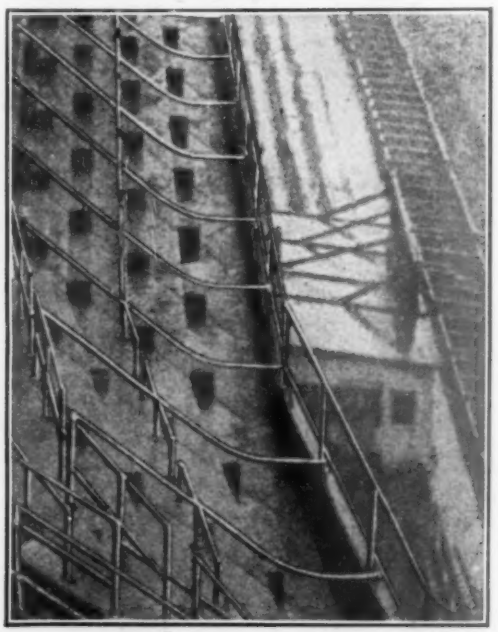


CONEY ISLAND BOARD-WALK RAILING

We manufacture and assemble:

Pipe Railing for Bridges
Pipe Railing for Culverts
Pipe Railing for Iron Stairs
Pipe Railing for Concrete Stairs
Pipe Railing for Grandstands
Pipe Railing for Board Walks
Pipe Railing for Runways
Pipe Structure for Backstops and Goal Posts
Pipe Columns, Pipe Racks, etc.

Above is shown a small section of the Coney Island Board-Walk Railing. In constructing this railing, it was necessary to take care of expansion, contraction and vibration. Our special fittings took care of this, and the job is considered one of the finest pipe railing jobs in the United States.



STADIUM AT AMERICAN LEAGUE BASEBALL PARK, NEW YORK CITY—25,000 FEET OF PIPE RAILING FURNISHED

Above is a view of a section of the upper stand of the stadium at the baseball park of the American League at New York City. Twenty-five thousand feet of pipe railing were furnished and erected by us on this stand.

On every pipe railing job the material is shipped, posts are assembled, horizontal rails are cut, threaded and marked for erection. Let us quote you prices, or send you our illustrated circular.

THE TEXAS COMPANY

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RID SCHOOL PLAYGROUNDS OF MUD AND DUST

The hours spent in the playground are important hours for the health of school children. During these recreation periods, every precaution should be taken to assure the children a maximum of benefit, with a minimum of danger.

DUST AND MUD, BREEDERS OF SICKNESS

Dust and mud on the playground hold out a constant threat to the children's health, and it is therefore essential that they be eliminated. These evils are most economically and efficiently done away with by means of TEXACO Surfacing Material, an asphaltic product.

WHAT TEXACO SURFACING MATERIAL DOES

TEXACO Surfacing Material, when applied to the playground surface, binds together into a thin, tough mat the particles which make up the surface. This mat is waterproof, and consequently does not permit the formation of mud. It is of pliable character, and when a child takes a tumble, he is not likely to be injured.

These advantages, together with the comparatively small expenditure necessary, make the use of TEXACO Surfacing Material on school playgrounds a desirable and feasible undertaking for every progressive community.

Further information and cost data on request

TEXACO

FOR DUSTLESS, WATERPROOF PLAYGROUNDS